TECHNICAL REPORT

ISO/IEC TR 15504-5

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Information technology — Software process assessment —

Part 5:
An assessment model and indicator guidance

Technologies de l'information — Évaluation de processus de logiciel —

Partie 5: Un modèle d'évaluation et guide des indicateurs

Reference number
ISO/IEC TR 15504-5:1999(E)

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

The main task of technical committees is to prepare International Standards, but in exceptional circumstances a technical committee may propose the publication of a Technical Report of one of the following types :

— type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts ;

— type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard ;

— type 3, where a technical committee has collected data of a different kind from that which is normally published as an International Standard (“state of the art”, for example).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

ISO/IEC TR 15504-5, which is a Technical Report of type 2, was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC7, *Software engineering*.

ISO/IEC TR 15504 consists of the following parts, under the general title *Information technology — Software process assessment:*

— *Part 1: Concepts and introductory guide*

— *Part 2: A reference model for processes and process capability*

— *Part 3: Performing an assessment*

— *Part 4: Guide to performing assessments*

— *Part 5: An assessment model and indicator guidance*

— *Part 6: Guide to competency of assessors*

— *Part 7: Guide for use in process improvement*

— *Part 8: Guide for use in determining supplier process capability*

— *Part 9: Vocabulary*

Annexes A to E of this part of ISO/IEC TR 15504 are for information only.

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Introduction

This part of ISO/IEC TR 15504 provides an example of assessment model for supporting process assessment. It also contains guidance of good software engineering practices to be considered when interpreting the intent of the reference model defined in ISO/IEC TR 15504-2. This guidance is provided in the form of indicators contained in this assessment model. These indicators may also be used when performing a process improvement program or to help evaluate and select an assessment model, method, methodology or tools.

An integral part of conducting an assessment is to use a model constructed for that purpose, compatible with the reference model defined in ISO/IEC TR 15504-2. The reference model cannot be used alone as the basis for conducting reliable and consistent assessments of process capability since the level of detail is not sufficient. The descriptions of process purpose and capability attributes in the reference model need to be supported with a comprehensive set of indicators of process performance and process capability. Used in this way, in conjunction with a reliable method, consistent and repeatable ratings of process capability will be possible.

This assessment model is compatible with the reference model described in ISO/IEC TR 15504-2. As an example, it embodies the core characteristics that could be expected of any compatible assessment model. Use of this assessment model is not required to meet the requirements of this ISO/IEC TR 15504; other models meeting the requirements of ISO/IEC TR 15504-2 may be used in a conformant assessment.

Within this part of ISO/IEC TR 15504 :

— clause 4 provides a detailed description of the structure and key components of the assessment model;

— clause 5 uses the definitions from ISO/IEC TR 15504-2, categorizing processes into 3 life cycle process groupings, five process categories and describing each process in terms of its purpose. It expands these definitions by including a set of base practices for each process. Annex A is directly linked to this clause as it continues the work of defining indicators of process performance by associating work products with each process. Annex C is also linked directly to annex A as it defines the work product characteristics;

— clause 6 repeats the definitions of the capability levels and process attributes from ISO/IEC TR 15504-2, that describe the capability of processes. It expands these definitions through the inclusion of sets of management practices for each attribute. Annex B is directly linked to this clause as it completes the work of defining indicators of process capability by associating practice performance characteristics and, resource and infrastructure characteristics to each management practices;

— clause 7 contains a declaration that the assessment model is compatible with the reference model and fully meets the requirements defined in ISO/IEC TR 15504-2;

— annex A contains the input and output work products associated with each process in this assessment model;

— annex B contains the process performance, resources and infrastructure characteristics and related processes associated with each management practice;

— annex C contains the characteristics for each work product;

— annex D contains a style guide for defining base practices;

— annex E contains a style guide for defining management practices;

— the Bibliography contains a list of informative references.

Annexes A to E of this part of ISO/IEC TR 15504 are for information only.

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Information technology — Software process assessment —

Part 5:
An assessment model and indicator guidance

1 Scope

This part of ISO/IEC TR 15504 :

— defines an example of assessment model that meets the requirements of ISO/IEC TR 15504 and that supports the performance of an assessment by providing indicators for guidance on the interpretation of the process purposes and process attributes defined in ISO/IEC TR 15504-2;

— provides guidance, by example, on the definition, selection and use of assessment indicators.

Any model meeting the requirements of ISO/IEC TR 15504-2 may be used for assessment. Different models and methods may be needed to address differing business needs. The assessment model in this part of ISO/IEC TR 15504 is provided as an example of a compatible model.

The indicators are used as guides in collecting the objective evidence that enables an assessor to assign ratings to process attributes. The set of indicators included in this part of ISO/IEC TR 15504 is not intended to be an all inclusive set nor is it intended to be applicable in its entirety. Subsets that are appropriate to the context and scope of the assessment should be selected, and possibly augmented with additional indicators.

By providing the assessment model, this part of ISO/IEC TR 15504 is directed at assessment sponsors and competent assessors who wish to select a model, and associated method, for assessment (for either capability determination or process improvement). Additionally it may be of use to model developers in the construction of a compatible model, by providing examples of good software engineering practice.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC TR 15504. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO/IEC TR 15504 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO/IEC TR 15504-2:1998, *Information technology — Software process assessment — Part 2: A reference model for processes and process capability.*

ISO/IEC TR 15504-9:1998, *Information technology — Software process assessment — Part 9: Vocabulary.*

3 Terms and definitions

For the purposes of this part of ISO/IEC TR 15504, the terms and definitions given in ISO/IEC TR 15504-9 and the following definitions apply.

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3.1
attribute indicator
an *assessment indicator* that supports the judgement of the extent of achievement of a specific *process attribute*

3.2
base practice
a software engineering or management activity that, when consistently performed, contributes to achieve the purpose of a particular process

3.3
management practice
a management activity or task that addresses the implementation or institutionalisation of a specific process attribute

3.4
tailored process
a defined process developed by tailoring a standard process definition.

4 Overview of the exemplar assessment model

4.1 Introduction

This part of ISO/IEC TR 15504 provides an exemplar assessment model that includes examples of appropriate indicators.

The reference model defined in ISO/IEC TR 15504-2 provides a common basis for performing assessments of software process capability, allowing for the reporting of results using a common rating scale.

The reference model defines a two-dimensional model of process capability. In one dimension, the process dimension, the processes associated with software are defined and classified into five process categories. In the second dimension, the capability dimension, a series of process attributes grouped into capability levels are defined. The process attributes provide the measurable characteristics of process capability.

The reference model cannot be used alone as the basis for conducting reliable and consistent assessments of process capability since the level of detail provided is not sufficient. The descriptions of process purpose and process attributes in the reference model need to be supported with comprehensive sets of indicators of process performance and capability.

The exemplar assessment model defined in this part of ISO/IEC TR 15504 is based upon and is compatible with the reference model, and can be used as the basis for conducting an assessment of software process capability.

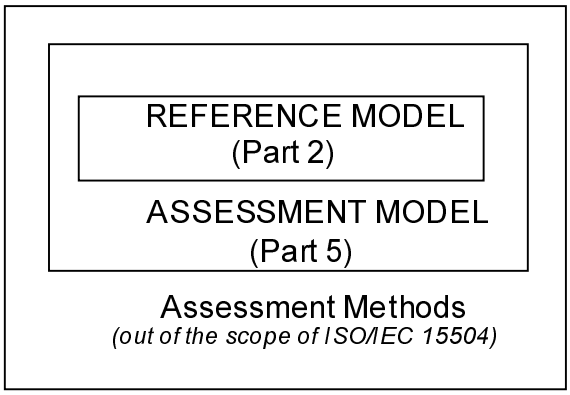

Figure 1 — The relationship between the reference model, the assessment model, and assessment methods

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In order to meet the requirements of ISO/IEC TR 15504, a documented process supporting the requirements of ISO/IEC TR 15504-3 is also required. This need may be met, for example, by the adoption of a supportive method for conducting assessments (see Figure 1). The definition of an example method is outside the scope of this part of ISO/IEC TR 15504.

4.2 Structure of the assessment model

This clause describes the structure of the model and its key components. Clause 5, together with its associated annexes A and C, describes the components of the process dimension and clause 6, with its associated annex B, describes the components of the capability dimension. Clause 7 provides a demonstration of compatibility that fully meets the requirements of ISO/IEC TR 15504-2.

The basic structure of this assessment model is identical to that of the reference model defined in ISO/IEC TR 15504-2. There is a one to one correspondence between the process categories, processes, purpose statements, process capability levels and process attributes of the reference model and those of this assessment model.

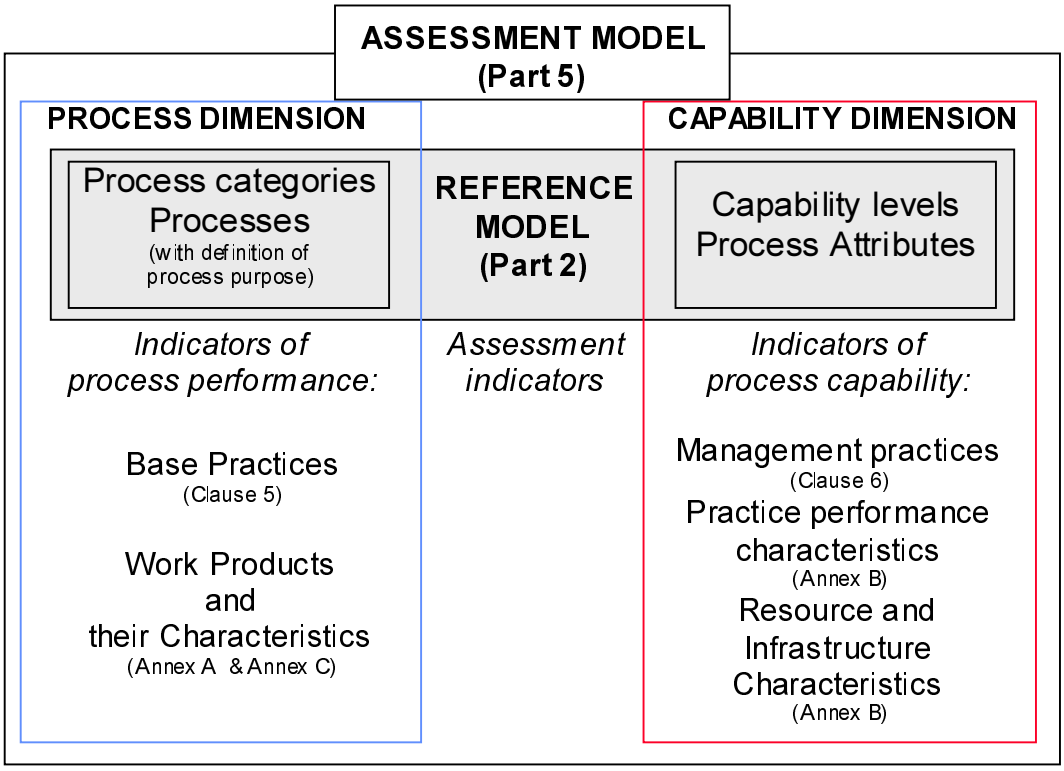

Figure 2 — Relationship between the reference model and the assessment model

This assessment model expands the reference model by adding the definition and use of assessment indicators (see Figure 2). Assessment indicators are defined to support an assessor's judgement of the performance and capability of an implemented process.

4.2.1 Indicators of process performance – the process dimension

Base practices, input and output work products and their associated characteristics relate to the processes defined in the process dimension of the reference model, and are chosen to explicitly address the achievement of the defined process purpose.

The base practices and work products are indicators of a level 1 process performance. The presence of the work products with the existence of the characteristics of the work products, and evidence of performance of the base practices, provide objective evidence of the achievement of the purpose of the process.

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4.2.2 Indicators of process capability – the capability dimension

Management practices relate to the process attributes defined in the process capability dimension of the reference model. Evidence of their effective performance supports the judgement of the degree of achievement of the attribute. Management practices are the principal indicators of process capability.

Management practices are linked with attribute indicator sets which are:

a) practice performance characteristics that provide guidance on the implementation of the practice;

b) resource and infrastructure characteristics that provide mechanisms for assisting in the management of the process; and

c) associated processes from the process dimension that support the management practice.

The set of management practices is intended to be applicable to all processes in the process dimension of the model. Evidence of the performance of the defined management practices can be derived from the practice performance characteristics. The practice performance characteristics and resource & infrastructure characteristics help to establish objective evidence of the extent of achievement of the specified process attribute.

4.3 Principles of the assessment model

The assessment model is based on the principle that the capability of a process can be assessed by demonstrating the achievement of process attributes. Each process in the process dimension has a set of associated base practices, the performance of which provides an indication of the extent of achievement of the process purpose. Similarly, each process attribute in the capability dimension has a set of associated management practices, the performance of which provides an indication of the extent of achievement of the attribute in the instantiated process.

The indicators defined in the assessment model represent types of objective evidence that might be found in an instantiation of a process and therefore could be used to judge achievement of capability.

4.4 The view of process performance – the process dimension

The assessment model groups the processes in the process dimension into five process categories, according to the type of activity they address. The groupings are identical to those in the reference model defined in ISO/IEC TR 15504-2.

The **Customer-Supplier** process category (CUS) consists of processes that directly impact the customer, support development and transition of the software to the customer, and provide for the correct operation and use of the software product and/or service.

The **Engineering** process category (ENG) consists of processes that directly specify, implement, or maintain the software product, its relation to the system and its customer documentation.

The **Support** process category (SUP) consists of processes which may be employed by any of the other processes (including other supporting processes) at various points in the software life cycle.

The **Management** process category (MAN) consists of processes which contain practices of a generic nature which may be used by anyone who manages any type of project or process within a software life cycle.

The **Organization** process category (ORG) consists of processes that establish the business goals of the organization and develop process, product, and resource assets which, when used by the projects in the organization, will help the organization achieve its business goals.

There are a number of processes associated with each process category. Each process in the assessment model is described in terms of a purpose statement. These statements contain the unique functional objectives of the process when instantiated in a particular environment. Satisfying the purpose statements of a process represents the first step in building a level 1 process capability. The process categories and their associated processes are described in Clause 5.

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A base practice is an activity that addresses the purpose of a particular process. Consistently performing the base practices associated with a process will help to consistently achieve its purpose. A coherent set of base practices is associated with each process in the process dimension.

The base practices are described at an abstract level, identifying "what" should be done without specifying "how". Implementing only the base practices of a process may be of minimal value and represents only the first step in building process capability, but the base practices represent the unique, functional activities of the process, even if that performance is not systematic. Performance of the base practices may be ad hoc, unpredictable, inconsistent, poorly planned, and/or result in products that do not meet their requirements. The performance of a process, however, produces work products that are at least marginally usable in achieving the purpose of the process. In this assessment model, each work product has a defined set of characteristics that may be used to assess the effective implementation of a process.

Clause 5 contains a complete description of the base practices. Annex A lists the processes and their related work products. Annex C lists the key characteristics of the work products.

4.5 The view of process capability – the capability dimension

Evolving process capability is expressed in the assessment model in terms of process attributes grouped into capability levels. The attributes and capability levels are identical to those defined in the reference model.

Process attributes are features of a process that can be evaluated on a scale of achievement, providing a measure of the capability of the process. They are applicable to all processes. Each process attribute describes a facet of the overall capability of managing and improving the effectiveness of a process in achieving its purpose and contributing to the business goals of the organization.

A capability level is a set of process attribute(s) that work together to provide a major enhancement in the capability to perform a process. Each level provides a major enhancement of capability in the performance of a process. The levels constitute a rational way of progressing through improvement of the capability of any process and are defined in ISO/IEC TR 15504-2.

There are six capability levels in the reference model, incorporating nine process attributes.

Level 0: Incomplete. There is general failure to attain the purpose of the process. There are little or no easily identifiable work products or outputs of the process.

Level 1: Performed. The purpose of the process is generally achieved. The achievement may not be rigorously planned and tracked. Individuals within the organization recognise that an action should be performed, and there is general agreement that this action is performed as and when required. There are identifiable work products for the process, and these testify to the achievement of the purpose.

Level 2: Managed. The process delivers work products according to specified procedures and is planned and tracked. Work products conform to specified standards and requirements. The primary distinction from the Performed Level is that the performance of the process now delivers work products that fulfil expressed quality requirements within defined timescales and resource needs.

Level 3: Established. The process is performed and managed using a defined process based upon good software engineering principles. Individual implementations of the process use approved, tailored versions of standard, documented processes to achieve the defined process outcomes. The resources necessary to establish the process definition are also in place. The primary distinction from the Managed Level is that the process of the Established Level is using a defined process that is capable of achieving its defined process outcomes.

Level 4: Predictable. The defined process is performed consistently in practice within defined control limits, to achieve its defined process goals. Detailed measures of performance are collected and analyzed. This leads to a quantitative understanding of process capability and an improved ability to predict and manage performance. Performance is quantitatively managed. The quality of work products is quantitatively known. The primary distinction from the Established Level is that the defined process is now performed consistently within defined limits to achieve its defined process outcomes.

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Level 5: Optimizing. Performance of the process is optimized to meet current and future business needs, and the process achieves repeatability in meeting its defined business goals. Quantitative process effectiveness and efficiency goals (targets) for performance are established, based on the business goals of the organization. Continuous process monitoring against these goals is enabled by obtaining quantitative feedback and improvement is achieved by analysis of the results. Optimizing a process involves piloting innovative ideas and technologies and changing non-effective processes to meet defined goals or objectives. The primary distinction from the Predictable Level is that the defined and standard processes now dynamically change and adapt to effectively meet current and future business goals.

Within the assessment model, the measure of capability is based upon the nine process attributes (PA) of the reference model. Process attributes are used to determine whether a process has reached a given capability. Each attribute measures a particular aspect of the process capability.

At each level there is no ordering between the process attributes; each attribute addresses a specific aspect of the capability level.

The process attributes themselves are evaluated on a four point ordinal scale of achievement, as defined in ISO/IEC TR 15504-2. They therefore provide insight into the specific aspects of process capability required to support process improvement and capability determination. The list of process attributes is shown in Table 1.

Table 1 — Capability levels and process attributes

Process Attribute ID	Capability Levels and Process Attributes
	Level 0 : Incomplete process
	Level 1 : Performed process
PA 1.1	Process performance
	Level 2 : Managed process
PA 2.1	Performance management
PA 2.2	Work product management
	Level 3 : Established process
PA 3.1	Process definition
PA 3.2	Process resource
	Level 4 : Predictable process
PA 4.1	Measurement
PA 4.2	Process control
	Level 5 : Optimizing process
PA 5.1	Process change
PA 5.2	Continuous improvement

The management practices are activities of a generic type, and are intended to be applicable to all processes. They are designed around the achievement of the principal management functions of planning, organizing, resourcing and controlling. There are usually, but not necessarily, four management practices for each attribute.

Associated with each management practice are practice performance characteristics and associated resource and infrastructure characteristics that represent the type of evidence that would substantiate judgements of the extent to which the management practice is performed.

Annex B contains a complete description of the set of indicators of process capability.

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4.6 Use of indicators in rating processes

An indicator is defined as an objective attribute or characteristic of a practice or work product that supports the judgement of the performance or capability of an implemented process. The assessment indicators, and their relationship to process performance and process capability, are shown in Figure 3.

The output from a process assessment is a set of process profiles, one for each instance of each process within the scope of the assessment. Each process profile consists of a set of the process attribute ratings for an assessed process. Each attribute rating represents a judgement by the assessor of the extent to which the attribute is achieved. In order to maximise the objectivity of these judgements, thereby improving the reliability and repeatability of the assessment, the judgements of the assessor are based upon a coherent set of documented objective evidence.

The indicators in this model give examples of evidence that an assessor might obtain, or observe, in the course of an assessment. The evidence obtained in the assessment, through observation of the implemented process, can be mapped onto the set of indicators to enable correlation between the implemented process and the processes defined in this assessment model. These indicators provide guidance for assessors in accumulating the necessary objective evidence to support their judgements of capability. They are not intended to be regarded as a mandatory set of check-list to be followed, but as guidance for an assessor in accumulating the necessary objective evidence to support they judgement of capability.

The evidence obtained should be recorded in a form that clearly identifies the indicators types and classes, so that the support for the assessor's judgement can be readily confirmed or verified as required by ISO/IEC TR 15504-3.

Indicators are used to confirm that certain practices are performed, having been able to collect possible objective evidence during an assessment. All such evidence comes either from the examination of work products of the processes assessed, or from statements made by the performers and managers of the processes.

The existence of base practices, work products, and work product characteristics, provide evidence of the performance of the processes associated with them. Similarly, the existence of management practices provides evidence of process capability.

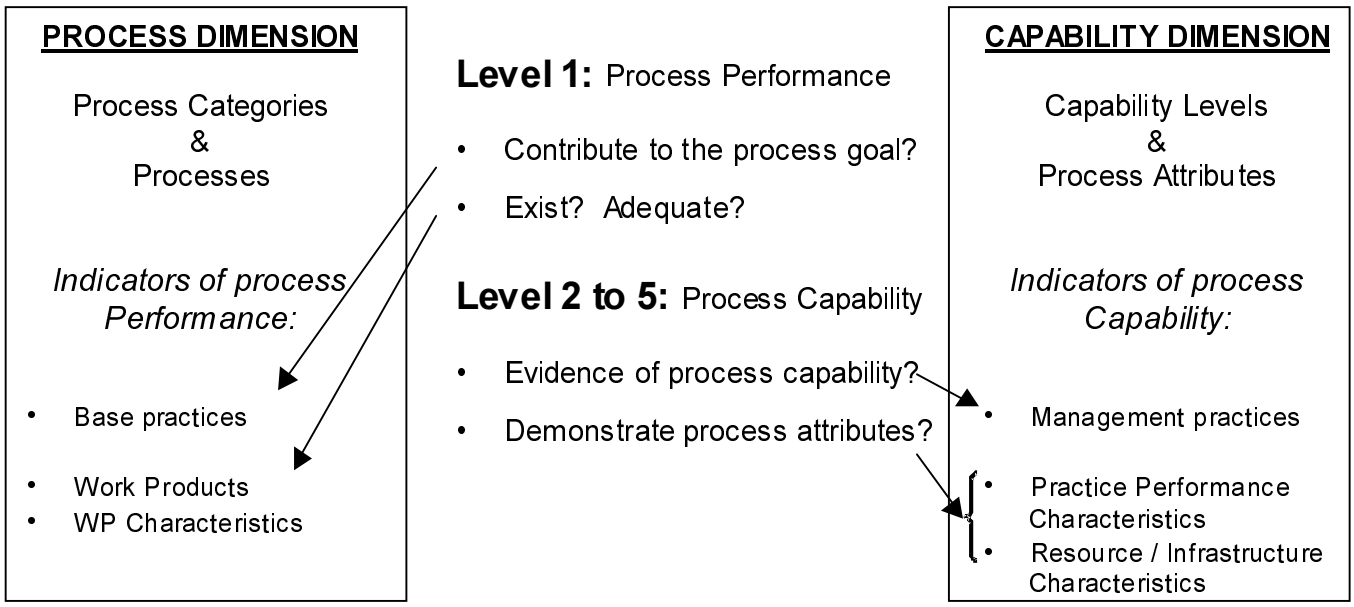

Figure 3 — The relationship between assessment indicators and process capability.

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4.7 Identification

4.7.1 Identification for elements of the assessment model

A nomenclature for practices is defined in order to identify them unambiguously and relate them to the architecture of the model. The nomenclature for base practices facilitates the identification of process categories, the processes that belong to each process category, and the base practices that belong to each process. For management practices, the nomenclature facilitates the identification of capability levels, the process attributes that belong to each capability level, and the management practices that belong to each process attribute. In software process assessments using the assessment model, the nomenclature and identifiers contained in this model should be used to identify practices referenced as evidence justifying the rating of a process attribute.

Each practice is linked to its parent entity, whether a process or a process attribute, through a numbering scheme, based upon the identifiers for processes and process attributes in the reference model.

Each practice is assigned an identifier consisting of a multi-part alphanumeric code.

For a base practice, the identifier is of the form : PC.PR.**BP**PN.

For a management practice, the identifier is of the form: **MP**CL.PA.PN.

Where the codes are:

- PC process category identifier
- PR process number (within the process category)
- BP the text "BP" used to signify Base Practice
- MP the text "MP" used to signify Management Practice
- CL capability level number
- PA process attribute number (within the capability level)
- PN practice number (within the process or process attribute)

For example, “ENG.1.3.BP1” denotes the base practice number 1 (Develop software architectural design) in the process category ENG (Engineering) for the process number 1.3 (Develop software design).

Similarly, “MP 2.2.1” denotes the management practice number 1 (Identify requirements) for the process attribute number 2 (Work product management attribute), capability level number 2 (Managed process).

Templates for constructing definition of new base practices and management practices are given in annex D and annex E respectively.

4.7.2 Work product identification

Each work product is assigned a sequential number based upon the listing in the table of work product characteristics in Annex C. Several work products listed are of a generic type (e.g. “Requirement specification (52)”). Where a specific instantiation of this generic type is included as an indicator, this is shown by the use of *italics* to indicate the specific reference (e.g. “*Software* requirement specification (52)”). Annex C gives a complete definition of the work product nomenclature.

5 The process dimension

This clause defines the process dimension of the assessment model. The process dimension is directly mapped to that of the reference model, and adopts the same process definitions and structure given by the reference model.

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The three life cycle process groupings are:

- The **Primary life cycle processes** consisting of the process categories Engineering and Customer-Supplier.
- The **Supporting life cycle processes** consisting of the process category Support.
- The **Organizational life cycle processes** consisting of the process categories Management and Organization.

The process dimension contains five process categories which are:

CUS Customer - Supplier

ENG Engineering

SUP Support

MAN Management

ORG Organization

The description of each process category includes a characterisation of the processes it contains, followed by a list of the process names.

The individual processes are described in terms of six components as defined in ISO/IEC TR 15504-2 : Process Identifier, Process Name, Process Type, Process Purpose, Process Outcomes and Process Notes.

In addition the process dimension of the assessment model provides information in the form of

a) a set of base practices for the process providing a definition of the tasks and activities needed to accomplish the process purpose and fulfil the process outcomes;

b) a number of input and output work products associated with each process;

c) characteristics associated with each work product.

The process purposes, outcomes and base practices are included in this clause. The work products associated with the processes and work product characteristics are contained in annex A and annex C respectively. The base practices, work products and work product characteristics constitute the set of indicators of process performance.

The process categories, processes and process type included in the process dimension of the assessment model are listed in table 2.

Table 2 — Processes and process categories

Process Category		**Process**	
ID	**Title**	**ID**	**Title and (Type of process)**
Primary Life Cycle processes			
CUS	**Customer Supplier process category**		
		CUS.1	Acquisition (basic)
		CUS.1.1	Acquisition preparation (component)
		CUS.1.2	Supplier selection (component)
		CUS.1.3	Supplier Monitoring (component)
		CUS.1.4	Customer Acceptance (component)
		CUS.2	Supply (basic)
		CUS.3	Requirements Elicitation (new)
		CUS.4	Operation (extended)
		CUS.4.1	Operational use (extended component)

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		CUS.4.2	Customer support (extended component)
ENG	**Engineering process category**		
	ENG.1	Development (basic)	
		ENG.1.1	System requirements analysis and design (component)
		ENG.1.2	Software requirements analysis (component)
		ENG.1.3	Software design (component)
		ENG.1.4	Software construction (component)
		ENG.1.5	Software integration (component)
		ENG.1.6	Software testing (component)
		ENG.1.7	System integration and testing (component)
	ENG.2	System and software maintenance (basic)	

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Table 2 — Processes and process categories *(continued)*

Process Category		Process	
ID	**Title**	**ID**	**Title and (Type of process)**
Supporting Life Cycle processes			
SUP	**Support process category**		
		SUP.1	Documentation (extended)
		SUP.2	Configuration management (basic)
		SUP.3	Quality assurance (basic)
		SUP.4	Verification (basic)
		SUP.5	Validation (basic)
		SUP.6	Joint review (basic)
		SUP.7	Audit (basic)
		SUP.8	Problem resolution (basic)
Organizational Life Cycle processes			
MAN	**Management process category**		
		MAN.1	Management (basic)
		MAN.2	Project management (new)
		MAN.3	Quality Management (new)
		MAN.4	Risk Management (new)
ORG	**Organization process category**		
		ORG.1	Organizational alignment (new)
		ORG.2	Improvement process (basic)
		ORG.2.1	Process establishment (component)
		ORG.2.2	Process assessment (component)
		ORG.2.3	Process improvement (component)
		ORG.3	Human resource management (extended)
		ORG.4	Infrastructure (basic)
		ORG.5	Measurement (New)
		ORG.6	Reuse (New)

5.1 Primary life cycle processes

The **Primary life cycle processes** consists of two process categories:

CUS Customer-Supplier

ENG Engineering

5.1.1 Customer-Supplier Process Category (CUS)

The *Customer-Supplier* process category consists of processes that directly impact the customer, support development and transition of the software to the customer, and provide for the correct operation and use of the software product and/or service.

The processes belonging to the Customer-Supplier process category are:

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CUS.1 Acquisition Process

CUS.1.1 Acquisition Preparation Process

CUS.1.2 Supplier Selection Process

CUS.1.3 Supplier Monitoring Process

CUS.1.4 Customer Acceptance Process

CUS.2 Supply Process

CUS.3 Requirements Elicitation Process

CUS.4 Operation Process

CUS.4.1 Operational Use Process

CUS.4.2 Customer Support Process

NOTE The "customer" can be external to the assessed organisation or internal, in which no contract is involved (e.g. development of software to meet a potential need elicited by market research, or in response to internally developed requirements for a potential customer.).

5.1.1.1 CUS.1 Acquisition process

Basic process

The purpose of the *Acquisition process* is to obtain the product and/or service that satisfies the need expressed by the customer. The process begins with the identification of a customer need and ends with the acceptance of the product and/or service needed by the customer. As a result of successful implementation of the process:

— acquisition needs, goals, acceptance criteria and acquisition strategies will be defined;

— a contract will be developed that clearly expresses the expectation, responsibilities and liabilities of both the customer and the supplier;

— a product and/or service will be produced that satisfies the customer's stated need;

— the acquisition will be monitored so that specified constraints such as cost, schedule and quality are met;

— supplier deliverables will be accepted.

Base Practices:

CUS.1.BP1 : Identify the need. Identify a need to acquire, develop, or enhance a system, software product, or software service.

CUS.1.BP2 : Prepare and negotiate contract. Negotiate a contract with the supplier that clearly expresses the expectation, responsibilities, and liabilities of both the customer and the supplier.

CUS.1.BP3 : Monitor the acquisition. Monitor the acquisition against the agreed acquisition documentation so that progress can be reviewed and audited to ensure that specified constraints such as cost, schedule, and quality are met.

5.1.1.2 CUS.1.1 Acquisition preparation process

Component process of CUS.1 - Acquisition process

The purpose of the *Acquisition preparation process* is to establish the needs and goals of the acquisition. As a result of successful implementation of the process:

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— the concept or the need to acquire, develop, or enhance a system, software product, or software process will be established;

— the customer's software and/or system requirements will be produced;

— an acquisition strategy will be developed;

— acceptance criteria will be defined.

Base Practices:

CUS.1.1.BP1 : Identify the need. Identify a need to acquire, develop, or enhance a system, software product or software service.

CUS.1.1.BP2 : Define the requirements. Identify the requirements for a system and/or software product that will satisfy the need for a new product and/or service.

CUS.1.1.BP3 : Prepare acquisition strategy. Prepare a strategy for the acquisition of the product.

CUS.1.1.BP4 : Define acceptance criteria. Establish and agree acceptance criteria and the means of evaluation to be used.

5.1.1.3 CUS.1.2 Supplier selection process

Component process of CUS.1 - Acquisition process

The purpose of the *Supplier selection process* is to choose the organization that will be responsible for the implementation of the project identified in CUS.1.1. As a result of successful implementation of the process:

— the acquisition requirements (e.g. request for proposal) will be produced;

— the supplier will be selected based upon the evaluation of the supplier's proposals;

— a contract will be established and negotiated between the customer and the supplier.

Base Practices:

CUS.1.2.BP1 : Define acquisition requirements. Identify and document the acquisition requirements (e.g. request for proposal).

CUS.1.2.BP2 : Select a supplier. Select a supplier based upon an evaluation of supplier proposals, capabilities and other factors that need to be considered.

CUS.1.2.BP3 : Prepare and negotiate contract. Negotiate a contract with the supplier that clearly expresses the expectation, responsibilities, and liabilities of both the customer and the supplier.

5.1.1.4 CUS.1.3 Supplier monitoring process

Component process of CUS.1 - Acquisition process

The purpose of the *Supplier monitoring process* is to monitor the supplier's activities during the development of the software product and/or service. As a result of successful implementation of the process:

— joint activities between the customer and the supplier will be performed as needed;

— information on technical progress will be exchanged regularly with the supplier;

— performance of the supplier will be monitored against the agreed requirements.

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Base Practices:

CUS.1.3.BP1 : Provide supplier feedback. Maintain communications with the customer, keeping it up to date with progress, costs, and risks to successful completion.

CUS.1.3.BP2 : **Review development with supplier**. Review technical aspects of the development on a regular basis with the supplier. This may include joint meetings with the supplier or formal communication to review the status for their requirements and requests.

NOTE Refer to the process *SUP.6 Joint review*.

CUS.1.3.BP3 : Monitor the acquisition. Monitor the acquisition against the agreed acquisition documentation so that progress can be reviewed and audited to ensure that specified constraints such as cost, schedule, and quality are met.

CUS.1.3.BP4 : Monitor supplier. Monitor the supplier against the agreed requirements.

5.1.1.5 CUS.1.4 Customer acceptance process

Component process of CUS.1 - Acquisition process

The purpose of the *Customer acceptance process* is to approve the supplier's deliverable when all acceptance conditions are satisfied. As a result of successful implementation of the process:

— acceptance will be based on the acquisition strategy and conducted according to the agreed acceptance criteria;

— the delivered software product and/or service will be evaluated with regard to the agreed requirements.

Base Practices:

CUS.1.4.BP1 : Evaluate the delivered product. Carry out the evaluation of the product or service against the agreed requirements.

CUS.1.4.BP2 : Accept the delivered product. Accept the product or service when all the acceptance conditions have been satisfied.

5.1.1.6 CUS.2 Supply process

Basic process

The purpose of the *Supply process* is to provide software to the customer that meets the agreed requirements. As a result of successful implementation of the process:

— a response to customer's request will be produced;

— a contract will be established between the customer and the supplier for developing, packaging, delivering, and installing the software product and/or service;

— a software product and/or service that meets the agreed requirements will be developed by the supplier;

— the software product and/or service will be delivered to the customer and installed in accordance with the agreed requirements.

Base Practices:

CUS.2.BP1 : Prepare response. Produce a proposal in response to the customer’s request for proposal.

CUS.2.BP2 : Negotiate contract. Establish a contract with the customer to provide the software product or service and review the contents of the contract before finalisation.

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CUS.2.BP3 : Develop system or software. Develop the system or software defined in the contract to meet the customer 's requirements.

CUS2.BP4 : Identify attributes for successful delivery and installation. Using the acceptance criteria and the software requirements, define a set of attributes that will result in the successful delivery and installation of the software.

CUS.2.BP5 : Deliver and install software. Supply the product in a manner acceptable to the customer, according to the identified attributes.

5.1.1.7 CUS.3 Requirements elicitation process

New process

The purpose of the *Requirements elicitation process* is to gather, process, and track evolving customer needs and requirements throughout the life of the software product and/or service so as to establish a requirements baseline that serves as the basis for defining the needed software work products. As a result of successful implementation of the process:

— continuing communication with the customer will be established;

— agreed customer requirements will be defined;

— a mechanism will be established to incorporate new customer requirements into the established requirements baseline;

— a mechanism will be established for continuous monitoring of customer needs;

— a mechanism will be established for ensuring that customers can easily determine the status and disposition of their requests;

— enhancements arising from changing technology and customer needs will be identified and their impact managed.

Base Practices:

CUS.3.BP1 : Obtain customer requirements and requests. Obtain and define customer requirements and requests through direct solicitation of customer and user input and through review of customer business proposals, target operating and hardware environment, and other documents bearing on customer requirements.

CUS.3.BP2 : Agree on requirements. Obtain agreement across teams on the customer’s requirements, obtaining the appropriate sign-offs by representatives of all teams and other parties contractually bound to work to these requirements.

CUS.3.BP3 : Establish customer requirements baseline. Document the customer's requirements and establish as a baseline for project use and monitoring against customer needs.

CUS.3.BP4 : Manage customer requirements changes. Manage all changes made to the customer requirements against the customer requirements baseline to ensure enhancements resulting from changing technology and customer needs are identified and that those who are affected by the changes are able to assess the impact and risks and initiate appropriate change control and mitigation actions.

NOTE The tracking of requirements is handled in *SUP.2 Configuration management process.*

CUS.3.BP5 : Understand customer expectations. Review with customers and users their requirements and requests to better understand their needs and expectations.

CUS.3.BP6 : Establish customer query mechanism. Provide a means by which the customer can be aware of the status and disposition of their requirements changes.

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NOTE This may include joint meetings with the customer or formal communication to review the status for their requirements and requests; refer to the process *SUP.6 Joint review*.

5.1.1.8 CUS.4 Operation process

Extended process

The purpose of the *Operation process* is to operate the software product in its intended environment and to provide support to the customers of the software product. As a result of successful implementation of the process:

— correct operation of the software in its intended environment will be evaluated;

— the software will be operated in its intended environment;

— assistance and consultation will be provided to the customers of the software product.

Base Practices:

CUS.4.BP1 : Software Operation. Operate the software in its intended environment.

CUS.4.BP2 : Operation evaluation. Evaluate the correct operation of the software.

CUS.4.BP3 : Support customer. Provide assistance and consultation to the customer for operation of the software.

5.1.1.9 CUS.4.1 Operational use process

Extended component process of CUS.4 - Operation process

The purpose of the *Operational use process* is to ensure the correct and efficient operation of the software product for the duration of its intended usage and in its installed environment. As a result of successful implementation of the process:

— operational risks for the software introduction and operation will be identified and monitored;

— the software will be operated in its intended environment according to requirements;

— assurance will be provided that software capacities are adequate to meet customer needs.

Base Practices:

CUS.4.1.BP1 : Identify operational risks. Identify and mitigate risks to system operation and functionality.

CUS.4.1.BP2 : Perform operational testing. Perform operational testing of each release of the software, assessing satisfaction against specified criteria.

CUS.4.1.BP3 : Operate the software. Operate the software in its intended environment and in the specified way.

CUS.4.1.BP4 : Review software operation problem. Review priorities for problem resolution with the customer.

CUS.4.1.BP5 : Resolve operational problems. Identify, record, and resolve problems arising from operation of the software (i.e. problems encountered by any individual interacting with the software).

NOTE The elimination of the cause of the operational problem will be handled by *SUP.8 Problem resolution process*.

CUS.4.1.BP6 : Handle user requests. Monitor, record, and respond to all user requests and problems relating to the software, forwarding as appropriate to the maintenance function.

NOTE The implementation of approved requests will be achieved through *ENG.2 System and software maintenance process*.

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CUS.4.1.BP7 : Document temporary work-arounds. Provide documented temporary work-arounds as appropriate to maintain operation of the system until a permanent solution to a problem can be found.

NOTE The customer should be informed of the status and availability of the permanent solution.

CUS.4.1.BP8 : Monitor system capacity and service. Provide the capability to monitor system capacity and operational service on a regular basis, where appropriate.

5.1.1.10 CUS.4.2 Customer support process

Extended component process of CUS.4 - Operation process

The purpose of the *Customer support process* is to establish and maintain an acceptable level of service to the customer to support effective use of the software product. Assistance and consultation to the customer is provided as requested to support the operation of the software product. As a result of successful implementation of the process:

— customer support service needs will be identified and monitored on an ongoing basis;

— customer satisfaction with both the support services being provided and the product itself will be evaluated on an ongoing basis;

— operational support will be provided by resolving operational problems and handling customer inquiries and requests;

— customer needs will be met through delivery of appropriate services.

Base Practices:

CUS.4.2.BP1 : Provide user training. Provide training and documentation, as appropriate, to the user so that the software can be effectively used.

CUS.4.2.BP2 : Establish product support. Establish a service by which the customer can raise problems and questions encountered in use of the software and receive help in resolving them.

NOTE The handling of problems will be handled in SUP.8 *Problem resolution process.*

CUS.4.2.BP3 : Monitor performance. Monitor the operational performance of the software in order to be aware of problems which might impact level of service.

CUS.4.2.BP4 : Determine customer satisfaction level. Determine the level of customer satisfaction with the software products and services received.

NOTE This may involve, as appropriate, field performance data, surveys, interviews, and studies. In some instances the end-user of the software may be different from the customer of the software. In this case, both the customer and end-user satisfaction levels should be determined.

CUS.4.2.BP5 : Compare with competitors. Compare and monitor the level of customer satisfaction obtained for the software and services received relative to that of competitors.

NOTE It may be necessary to obtain information on competitors from third party sources. It may also be necessary to include information on how competitors define:

customer satisfaction;
measurement techniques;
criteria;
collection and evaluation methods;

to provide a meaningful comparison.

Where comparative data is not available, absolute targets (e.g. % customers very satisfied, % repeat business) may be used as a basis for planning.

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CUS.4.2.BP6 : Communicate customer satisfaction. Communicate customer satisfaction data throughout the supplier organization, in a manner appropriate to the staff involved and the nature of the findings.

5.1.2 Engineering process category (ENG)

The *Engineering process category* consists of processes that directly specify, implement or maintain the software product, its relation to the system and its customer documentation. In circumstances where the system is composed totally of software, the Engineering processes deal only with the construction and maintenance of such software.

The processes belonging to the Engineering process category are:

ENG.1 Development process

ENG.1.1 System requirements analysis and design process

ENG.1.2 Software requirements analysis process

ENG.1.3 Software design process

ENG.1.4 Software construction process

ENG.1.5 Software integration process

ENG.1.6 Software testing process

ENG.1.7 System integration and testing process

ENG.2 System and software maintenance process

5.1.2.1 ENG.1 Development process

Basic process

The purpose of the *Development process* is to transform a set of requirements into a functional software product or software-based system that meets the customer's stated needs. As a result of successful implementation of the process:

— a software product or software-based system will be developed;

— intermediate work products will be developed that demonstrate that the end product is based upon the requirements;

— consistency will be established between requirements and designs;

— evidence (for example, testing evidence) will be provided that demonstrates that the end product meets the requirements;

— the end product will be installed in the target operating environment and accepted by the customer.

NOTE The requirements may be provided by operation of the *Acquisition process*, (CUS.1) or the *Requirements elicitation process* (CUS.3).

Base Practices:

ENG.1.BP1 : Define and implement the software or system development process. Use the scope and scale of the software product or system to be developed as the basis for defining the activities and tasks that will required to develop the product or system in an effective, efficient, economic manner.

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ENG.1.BP2 : Define and implement the traceability process. Use the activities in the development process to define the intermediate work products and methods for tracing requirements through those work products to the software product or system that is accepted by the customers.

ENG.1.BP3 : Define and implement the testing process. Use the customer requirements and intermediate work product definitions to define the scope, scale and methods of testing that are necessary to demonstrate that the software product or system that is delivered to the customer meets its design criteria and the customer requirements.

ENG.1.BP4 : Define and implement the delivery process. Use the customer requirements and knowledge of the target environment to define the activities that promote the software product or system from the development environment to the customer's target environment. Consideration should be given to schedules, resources and method of delivery, especially in the case of transition from an existing software product or system to the new one.

5.1.2.2 ENG.1.1 System requirements analysis and design process

Component process of ENG.1 - Development process

The purpose of the *System requirements analysis and design process* is to establish the system requirements (functional and non-functional) and architecture, identifying which system requirements should be allocated to which elements of the system and to which releases. As a result of successful implementation of the process:

— requirements of the system will be developed that match the customer's stated needs;

— a solution will be proposed that identifies the main elements of the system;

— the requirements will be allocated to each of the main elements of the system;

— a release strategy will be developed that defines the priority for implementing system requirements;

— the system requirements will be approved and updated as needed;

— the requirements, proposed solution, and their relationships will be communicated to all affected parties.

Base Practices:

ENG.1.1.BP1 : Identify system requirements. Use the customer requirements as the basis for defining the required functions and capabilities of the system and document in a system requirements specification.

ENG.1.1.BP2 : Analyze system requirements. Analyze the prioritized requirements, identifying the necessary elements of the system and the interfaces between them.

ENG.1.1.BP3 : Describe system architecture. Establish the top-level system architecture.

ENG.1.1.BP4 : Allocate requirements. Allocate all system requirements to the elements of the top-level system architecture.

NOTE The result of performing base practices ENG.1.1.BP1 to ENG.1.1.BP4 is a documented product configuration which describes the position of each element in the system architecture and the requirements which it must address.

ENG.1.1.BP5 : Develop release strategy. Map prioritized system requirements to future releases of the system.

ENG.1.1.BP6 : Communicate system requirements. Establish communication mechanisms for dissemination of system requirements, and updates to requirements to all parties who will be using them.

ENG.1.1.BP7 : Establish traceability. Establish traceability between the customer needs and the system requirements.

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5.1.2.3 ENG.1.2 Software requirements analysis process

Component process of ENG.1 - Development process

The purpose of the *Software requirements analysis process* is to establish the requirements of the software components of the system. As a result of successful implementation of the process:

— the requirements allocated to software components of the system and their interfaces will be defined to match the customer's stated needs;

— analyzed, correct, and testable software requirements will be developed;

— the impact of software requirements on the operating environment will be understood;

— a software release strategy will be developed that defines the priority for implementing software requirements;

— the software requirements will be approved and updated as needed;

— consistency will be established between system requirements and design and software requirements;

— the software requirements will be communicated to all affected parties.

Base Practices:

ENG.1.2.BP1 : Specify software requirements. Determine and analyze requirements of the software components of the system and document in a software requirements specification.

ENG.1.2.BP2 : Determine operating environment impact. Determine the interfaces between the software requirements and other components of the operating environment, and the impact that the requirements will have.

NOTE The operating environment includes tasks performed by, or other systems used by, the intended users of the software product.

ENG.1.2.BP3 : Evaluate and validate requirements with customer. Communicate the software requirements to the customer, and based on what is learned through this communication, revise if necessary.

ENG.1.2.BP4 : Develop validation criteria for software. Use the software requirements to define the validation criteria for the software. The validation criteria are used in developing the software tests.

ENG.1.2.BP5 : Develop release strategy. Prioritize the software requirements and map them to future releases of the software.

ENG.1.2.BP6 : Update requirements. After completing an iteration of requirements, design, code, and test, use the feedback obtained from operation to modify the requirements for the next iteration.

ENG.1.2.BP7 : Communicate software requirements. Establish communication mechanisms for dissemination of software requirements, and updates to requirements to all parties who will be using them.

ENG.1.2.BP8 : Evaluate the software requirements. Evaluate the consistency and establish traceability between software requirements and system requirements.

5.1.2.4 ENG.1.3 Software design process

Component process of ENG.1 - Development process

The purpose of the *Software design process* is to define a design for the software that implements the requirements and can be tested against them. As a result of successful implementation of the process:

— an architectural design will be developed that describes the major software components that will implement the software requirements;

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— internal and external interfaces of each software component will be defined;

— a detailed design will be developed that describes software units that can be built and tested;

— consistency will be established between software requirements and software designs.

Base Practices:

ENG.1.3.BP1 : Develop software architectural design. Transform the software requirements into a software architecture that describes the top-level structure and identifies its major components.

ENG.1.3.BP2 : Design interfaces. Develop and document a design for the external and internal interfaces.

ENG.1.4.BP3 : Verify the software design. Verify that the software design satisfies related software requirements.

ENG.1.3.BP4 : Develop detailed design. Decompose the top level design into a detailed design for each software component. The software components are refined into lower levels containing software units. The result of this base practice is a documented software design document which describes the position of each software unit in the software architecture.

NOTE The detailed design includes the specification of interfaces between the software units.

ENG.1.3.BP5 : Establish Traceability. Establish traceability between the software requirements and the software design.

5.1.2.5 ENG.1.4 Software construction process

Component process of ENG.1 - Development process

The purpose of the *Software construction process* is to produce executable software units and to verify that they properly reflect the software design. As a result of successful implementation of the process:

— verification criteria will be defined for all software units against their requirements;

— software units defined by the design will be produced;

— consistency will be established between software requirements and design and software components;

— verification of the software units against the design will be accomplished.

NOTE Part of this process is similar to the process *Verification process* (SUP.4).

Base Practices:

ENG.1.4.BP1 : Develop software units. Develop and document each software unit.

NOTE This base practice involves creating and documenting, the final representations of each software unit.

ENG.1.4.BP2 : Develop unit verification procedures. Develop and document procedures for verifying that each software unit satisfies its design requirements.

NOTE The normal verification procedure will be through unit testing, and the verification procedure will include unit test cases and unit test data.

ENG.1.4.BP3 : Verify the software units. Verify that each software unit satisfies its design requirements and document the results.

ENG.1.4.BP4 : Establish traceability. Establish traceability between the software design and the software units and ensure consistency with software requirements.

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5.1.2.6 ENG.1.5 Software integration process

Component process of ENG.1 - Development process

The purpose of the *Software integration process* is to combine the software units, producing integrated software items and to verify that the integrated software units properly reflect the software design. As a result of successful implementation of the process:

— an integration strategy will be developed for software units consistent with the release strategy;

— verification criteria for software items will be developed that ensure compliance with the software requirements allocated to the items;

— software items defined by the integration strategy will be produced;

— software items will be verified using the defined acceptance criteria;

— results of integration testing will be recorded;

— consistency will be established between software requirements and software items;

— a regression strategy will be developed for reverifying software items should a change in software units occur;

— regression testing will be carried out as necessary.

NOTE Part of this process is similar to the process *Verification process* (SUP.4).

Base Practices:

ENG.1.5.BP1 : Develop software integration strategy. Develop the strategy for integrating software units consistent with the release strategy. Identify aggregates of software units and a sequence or order for testing them.

NOTE Typically, the software architecture and the release strategy will have some influence on the selection of aggregates.

ENG.1.5.BP2 : Develop integrated software item regression test strategy. Develop the strategy for retesting integrated software items should a change in a given software unit be made.

ENG.1.5.BP3 : Develop tests for integrated software items. Describe the tests to be run against each integrated software item, indicating software requirements being checked, input data and verification criteria.

ENG.1.5.BP4 : Test integrated software items. Test each integrated software item against the verification criteria, and document the results.

ENG.1.5.BP5 : Integrate software item. Integrate the aggregated software items to form a complete software system. Ensure consistency between software requirements and software designs.

ENG.1.5.BP6 : Regression test integrated software items. If changes are made to software units carry out regression testing as defined in the regression test strategy.

5.1.2.7 ENG.1.6 Software testing process

Component process of ENG.1 - Development process

The purpose of the *Software testing process* is to test the integrated software producing a product that will satisfy the software requirements. As a result of successful implementation of the process:

— acceptance criteria for integrated software will be developed that verify compliance with the software requirements;

— integrated software will be verified using the defined acceptance criteria;

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— test results will be recorded;

— a regression strategy will be developed for retesting the integrated software should a change in software items be made;

— regression testing will be carried out as necessary.

Base Practices:

ENG.1.6.BP1 : Develop integrated software test strategy, including regression strategy. Develop the strategy for testing the software, and for retesting aggregates should a change in a given software item be made.

ENG.1.6.BP2 : Develop tests for integrated software. Describe the tests to be run against the complete software product, indicating software requirements being checked, input data, and verification criteria. The set of tests should demonstrate compliance with the software requirements.

NOTE Tests can be developed during process, ENG.1.2, *Software requirements analysis process*, ENG1.3, *Software design process* and ENG.1.4, *Software construction process*. Commencement of test development should generally not wait until software integration.

ENG.1.6.BP3 : Test integrated software. Test the integrated software against the verification criteria, and document the results.

ENG.1.6.BP4 : Regression test integrated software. If changes are made to software items carry out regression testing as defined in the regression test strategy.

5.1.2.8 ENG.1.7 System integration and testing process

Component process of ENG.1 - Development process

The purpose of the *System integration and testing process* is to integrate the software component with other components, such as manual operations or hardware, producing a complete system that will satisfy the customers' expectations expressed in the system requirements. The resources allocated to system integration should include someone familiar with the software component. As a result of successful implementation of the process:

— an integration strategy will be developed to build system unit aggregates according to the release strategy;

— acceptance criteria for each aggregate will be developed to verify compliance with the system requirements allocated to the units;

— system aggregates will be verified using the defined acceptance criteria;

— an integrated system demonstrating compliance with the system requirements (functional, non-functional, operations and maintenance) and validation that a complete set of useable deliverable components exists, will be constructed;

— test results will be recorded;

— a regression strategy will be developed for retesting aggregates or the integrated system should a change be made to existing components ;

— regression testing will be carried out as necessary.

NOTE Part of this process is similar to the processes *Verification Process* (SUP.4) and *Validation process* (SUP.5).

Base Practices:

ENG.1.7.BP1 : Develop system integration and test strategy. Develop the strategy for integrating system units consistent with the release strategy and for testing the system.

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ENG.1.7.BP2 : Develop system regression test strategy. Develop the strategy for retesting aggregates should a change in a given system item be made.

ENG.1.7.BP3 : Build aggregates of system units. Identify aggregates of system units and a sequence or order for testing them.

NOTE Typically, the system architecture and the release strategy will have some influence on the selection of aggregates.

ENG.1.7.BP4 : Develop tests for system aggregates. Describe the tests to be run against each system aggregate, indicating requirements being checked, input data, system components needed to perform the test, and validation criteria.

ENG.1.7.BP5 : Test system aggregates. Test each system aggregate and ensure that it satisfies its requirements, and document the results.

ENG.1.7.BP6 : Develop tests for system. Describe the tests to be run against the integrated system, indicating system requirements being checked, input data, and validation criteria.

NOTE 1 This can be performed during process ENG.1.1, *System requirements analysis and design process*.

NOTE 2 The set of tests should demonstrate compliance with the system requirements.

ENG.1.7.BP7 : Test integrated system. Test the integrated system and ensure that it satisfies the system requirements, and document the results.

ENG.1.7.BP8 : Regression test system aggregates or integrated system. If changes are made to system components carry out regression testing as defined in the regression test strategy.

5.1.2.9 ENG.2 System and software maintenance process

Basic process

The purpose of the *System and software maintenance process* is to manage modification, migration and retirement of system components (such as hardware, software, manual operations and network if any) in response to customer requests. The origin of requests might be a discovered problem or the need for improvement or adaptation. The objective is to modify and/or retire existing systems and/or software while preserving the integrity of organizational operations. As a result of successful implementation of the process:

— a maintenance strategy will be developed to manage modification, migration and retirement of system components according to the release strategy;

— the impact of organization, operations and interfaces on the existing system in operation will be defined;

— specifications, design documents and test strategies will be updated;

— modified system components will be developed with associated tests that demonstrate that the system requirements will not be compromised;

— system and software upgrades will be migrated to the customer's environment;

— on request, software and systems will be retired from use in a controlled manner that minimizes disturbance to the customers.

NOTE 1 The initial defined requirements may be provided by the *Requirements elicitation process* (CUS.3).

NOTE 2 This process interacts closely with other processes such as *Operation process* (CUS.4), *Customer support process* (CUS.4.2), and *Problem resolution process* (SUP.8).

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Base Practices:

ENG.2.BP1 : Determine maintenance requirements. Determine the system and software maintenance requirements, identifying the system and software elements to be maintained, and their required enhancements.

ENG.2.BP2 : Develop maintenance strategy. Develop the strategy for managing modification, migration, and retirement of system components consistent with the maintenance requirements and the release strategy.

NOTE Some of the required enhancements may have been previously planned but deferred.

ENG 2.BP3 : Analyze user problems and enhancements. Analyze user problems and requests and required enhancements, evaluating the possible impact of different options for modifying the operational system and software, system interfaces, and requirements.

NOTE This Base Practice links to the process SUP.8, *Problem resolution process.*

ENG.2.BP4 : Determine modifications for next upgrade. Based on the above analyses, determine which modifications should be applied in the next system or software upgrade, documenting which software items, units and other system elements and which documentation will need to be changed and which tests will need to be run.

ENG.2.BP5 : Implement and test modifications. Use the other engineering processes, as appropriate, to implement and test the selected modifications, demonstrating that the unmodified system and software requirements will not be compromised by the upgrade.

ENG.2.BP6 : Upgrade user system. Migrate the upgraded system and software with applied modifications to the user's environment, providing for, as appropriate

- parallel operation of the previous and upgraded systems;
- additional user training;
- support options;
- retirement of the previous system.

ENG.2.BP7 : Retire user system. Following approval, retire the obsolete system from the user environment, providing for, as appropriate

- parallel operation with replacement systems
- conversion of data to new or replacement systems
- archiving of system and data files
- user training for the conversion program.

5.2 Supporting life cycle processes

The **Supporting life cycle** processes consist of one process category:

SUP Support

5.2.1 Support process category (SUP)

The *Support process category* consists of processes that may be employed by any of the other processes (including other supporting processes) at various points in the software life cycle.

The processes belonging to the Support process category are:

SUP.1 Documentation Process

SUP.2 Configuration Management Process

SUP.3 Quality Assurance Process

SUP.4 Verification Process

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SUP.5 Validation Process

SUP.6 Joint Review Process

SUP.7 Audit Process

SUP.8 Problem Resolution Process

5.2.1.1 SUP.1 Documentation process

Extended process

The purpose of the *Documentation process* is to develop and maintain documents that record information produced by a process or activity. As a result of successful implementation of the process:

— a strategy identifying the documents to be produced during the life cycle of the software product will be developed;

— the standards to be applied for the development of documents will be identified;

— all documents to be produced by the process or project will be identified;

— the content and purpose of all documents will be specified, reviewed and approved;

— all documents will be developed and published in accordance with identified standards;

— all documents will be maintained in accordance with specified criteria.

NOTE The process supports performance of the process attribute 2.2 in those instances where it is invoked.

Base Practices:

SUP.1.BP1 : Develop documentation policy. Determine documentation policy which addresses where, when and what should be documented during the life cycle of the software product/service.

SUP.1.BP2 : Establish standards for documents. Establish standards for developing, modifying and maintaining documents.

SUP.1.BP3 : Specify documentation requirements. Specify requirements for documents such as title, date, identifier, version history, author(s), reviewer, authorizer, outline of contents, purpose; distribution list.

SUP.1.BP4 : Develop document. Develop documents at required process points according to established standards and policy.

SUP.1.BP5 : Check document. Review documents before distribution, and authorize documents before distribution or release.

NOTE 1 In the case of user documentation, this is a particularly important base practice, because documentation intended for use by system and software users should accurately describe the system and software and how it is to be used in a manner which is clear and useful to the user.

NOTE 2 Documents should be checked through verification or validation process with stakeholders.

SUP.1.BP6 : Distribute document. Distribute and confirm delivery of documents, where necessary, via appropriate media to specified audiences.

SUP.1.BP7 : Maintain document. Maintain documents according to the defined procedures.

NOTE If the document is part of a product baseline or if its control and stability are important, it should be modified and distributed in accordance with process *SUP.2 Configuration management*. If the document is part of a product baseline under maintenance, its maintenance is covered by process *ENG.2 System and software maintenance*.

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5.2.1.2 SUP.2 Configuration management process

Basic process

The purpose of the *Configuration management process* is to establish and maintain the integrity of all the work products of a process or project. As a result of successful implementation of the process:

— a configuration management strategy will be developed;

— all items generated by the process or project will be identified, defined and baselined;

— modifications and releases of the items will be controlled;

— the status of the items and modification requests will be recorded and reported;

— the completeness and consistency of the items will be ensured;

— storage, handling and delivery of the items will be controlled.

NOTE The process supports performance of the process attribute 2.2 in those instances where it is invoked.

Base Practices:

SUP.2.BP1 : Develop configuration management strategy. Determine configuration management strategy, including configuration management activities and schedule for performing these activities.

SUP.2.BP2 : Establish configuration management system. Establish a configuration management system including libraries, standards, procedures and tools.

SUP.2.BP3 : Identify configuration items. Identify configuration items, such as software system, modules, components and related documents by identifying the documentation that establishes the baseline; the version references and other relevant identification details.

SUP.2.BP4 : Maintain configuration item description. Maintain a up-to-date description of each configuration item.

NOTE The description should identify :

- its decomposition into lower level configuration components;
- who is responsible for each item;
- when it is placed under configuration management.

SUP.2.BP5 : Manage changes. Record and report status of configuration items and modification requests. Changes to any configuration items should be reviewed and authorized.

SUP.2.BP6 : Manage product releases. Release and delivery of any configuration items should be reviewed and authorized.

SUP.2.BP7 : Maintain configuration item history. Maintain a history of each configuration item in sufficient detail to recover a previously baselined versions when required.

SUP.2.BP8 : Report configuration status. Regularly report status of each configuration item and their relationship in the current system integration.

SUP.2.BP9 : Manage the release and delivery of configuration items. The storage, handling, release and delivery of the configuration items should be controlled.

5.2.1.3 SUP.3 Quality assurance process

Basic process

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The purpose of the *Quality assurance process* is to provide assurance that work products and processes of a process or project comply with their specified requirements and adhere to their established plans. As a result of successful implementation of the process:

— a strategy for conducting the quality assurance process activities and tasks will be developed, implemented and maintained;

— evidence of quality assurance activities and tasks will be produced and maintained;

— problems or non-conformances with contract requirements will be identified;

— adherence of software products, processes and activities to the applicable standards, procedures and requirements will be verified objectively.

NOTE 1 To be unbiased, quality assurance must have organizational freedom and authority from persons directly responsible for developing the software product or executing the process.

NOTE 2 Quality assurance should be coordinated with, and may make use of, the results of other supporting processes such as Verification, Validation, Joint reviews, Audits, and Problem resolution.

NOTE 3 Establishment of a quality management system in accordance with ISO 9001 will establish a capable quality assurance process.

NOTE 4 The process supports performance of the process attributes 2.1 and 2.2 in those instances where it is invoked.

Base Practices:

SUP.3.BP1 : Develop quality assurance strategy. Develop, implement and maintain quality policy, scope of assurance and responsibilities for quality.

SUP.3.BP2 : Establish quality standards. Establish quality standards for each process and work product.

SUP.3.BP3 : Define quality records. Define quality records that demonstrate conformance of process and work products to quality standards.

SUP.3.BP4 : Assure quality of process activities. Carry out a series of activities to provide the required level of confidence that the software processes have followed the specified standards.

SUP.3.BP5 : Assure quality of work products. Carry out a series of activities to provide the required level of confidence that the work products meet the quality standards and requirements.

SUP.3.BP6 : Report quality results. Report performances, deviations, and trends of the above activities to appropriate audience.

SUP.3.BP7 : Handle deviations. Any deviations should be reported, analyzed, corrected and further prevented.

5.2.1.4 SUP.4 Verification process

Basic process

The purpose of the *Verification process* is to confirm that each software work product and/or service of a process or project properly reflects the specified requirements. As a result of successful implementation of the process:

— a verification strategy will be developed and implemented;

— criteria for verification of all required software work products will be identified;

— required verification activities will be performed;

— identified defects will be found and removed from software work products;

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— results of the verification activities will be made available to the customer and other involved organizations.

NOTE 1 The process supports performance of the process attribute 2.1 and 2.2 in those instances where it is invoked.

NOTE 2 The process normally involves the performance of testing of the work products to ensure that they fulfil their intended use.

NOTE 3 The process is closely linked with performance of the *Software testing process* (ENG.1.6) and *System integration and testing process* (ENG.1.7).

NOTE 4 ISO/IEC 12207 contains specific requirements for the content of the verification plan.

NOTE 5 ISO/IEC 12207 contains specific criteria for verification activities that are dependent on the object of the verification activity.

NOTE 6 The process may involve performance of techniques including peer reviews, formal proof and traceability analysis, among others.

Base Practices:

SUP.4.BP1 : Develop verification strategy. Develop a verification strategy specifying the criteria for verification of all required work products.

SUP.4.BP2 : Conduct verification. Verify identified work products according to specified strategy.

SUP.4.BP3 : Determine actions for verification results. Analyze problems found in verification and determine action to solve the problems.

SUP.4.BP4 : Track actions for verification results. Track status and results of actions for correcting problems identified in verification. The results should be made available to the customer and other involved organizations.

5.2.1.5 SUP.5 Validation process

Basic process

The purpose of the *Validation process* is to confirm that the requirements for a specific intended use of the software work product are fulfilled. As a result of successful implementation of the process:

— a validation strategy will be developed and implemented;

— criteria for validation of all required work products will be identified;

— required validation activities will be performed;

— all identified problems will be resolved;

— evidence will be provided that the software work products as developed are suitable for their intended use;

— results of the validation activities will be made available to the customer and other involved organizations.

NOTE 1 This process is closely linked with performance of the *System integration and testing process* (ENG.1.7).

NOTE 2 The process normally involves the performance of testing of the work products to ensure that they fulfil their intended use.

Base Practices:

SUP.5.BP1 : Develop Validation Strategy. Develop a validation strategy specifying the criteria for verification of all required work products.

SUP.5.BP2 : Perform validation. Conduct validation using identified techniques, processes, and test cases against requirements and quality standards.

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SUP.5.BP3 : Determine actions for validation results. Analyze problems found in validation and determine action to the problems.

SUP.5.BP4 : Track actions for validation results. Track status and results of actions for correcting problems identified in validation. The results should be made available to the customer and other involved organization.

5.2.1.6 SUP.6 Joint review process

Basic process

The purpose of the *Joint review process* is to maintain a common understanding with the customer of the progress against the objectives of the contract and what should be done to help ensure development of a product that satisfies the customer. Joint reviews are at both project management and technical levels and are held throughout the life of the project. As a result of successful implementation of the process:

— periodic reviews will be held at predetermined milestones;

— the status and products of an activity of a process will be evaluated through joint review activities between the customers, suppliers and other stakeholders (or interested parties);

— review results will be made known to all affected parties;

— action items resulting from reviews will be tracked to closure.

NOTE 1 The process supports performance of the process attribute 2.1 in those instances where it is invoked.

NOTE 2 The process is most commonly invoked in circumstances where performance of a project is governed by a form of contract.

NOTE 3 ISO/IEC 12207 contains specific requirements for project management reviews and for technical reviews.

Base Practices:

SUP.6.BP1 : Prepare joint review. For preparing a joint internal (inter-process) or external (developer/customer) review, the following items should be prepared:

- scope of review;
- topics for review;
- attendees;
- distribution list of affected parties;
- responsibilities of attendants;
- desired outputs;
- a schedule;
- resource and facility requirements.

SUP.6.BP2 : Establish review criteria. Establish criteria for a joint review, such as for problem identification, resolution and agreement.

SUP.6.BP3 : Conduct joint management review. Conduct periodic joint management reviews to evaluate and assess:

- proposal against requirements;
- achievement against project plan and schedule;
- risks;
- readiness to transfer to the next process.

SUP.6.BP4 : Conduct joint technical review. Conduct periodic joint technical reviews to evaluate and assess technical issues and status against customer requirements and acceptance criteria documented in the contract.

SUP.6.BP5 : Conduct joint process review. Conduct periodic joint process reviews to evaluate and assess suitability and capability of the current processes for a project.

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SUP.6.BP6 : Conduct joint system acceptance review. Conduct joint system acceptance review to demonstrate to the customer that the final system's completeness and correctness in configuration and functionality complies with appropriate standards and specifications, and satisfies the acceptance criteria documented in the contract.

SUP.6.BP7 : Determine actions for review results. Analyze review report; distribute review report; propose resolution(s) for the review results; determine priority for actions.

SUP.6.BP8 : Track actions for review results. Track actions for resolutions of identified problems in a review; report and document changes of work products and processes.

5.2.1.7 SUP.7 Audit Process

Basic process

The purpose of the *Audit process* is to independently determine compliance of selected products and processes with the requirements, plans and contract, as appropriate. As a result of successful implementation of the process:

— an audit strategy will be developed and implemented;

— audits will be held at predetermined milestones;

— compliance of selected software work products and/or services or processes with requirements, plans and contract will be determined according to the audit strategy;

— the conduct of audits by an appropriate independent party will be arranged;

— problems detected during an audit will be identified, communicated to those responsible for corrective action, and resolved.

NOTE 1 The process supports performance of the process attribute 2.1 in those instances where it is invoked.

NOTE 2 This process may be employed by any two parties, where one party (auditing party) audits the software products or activities of another party (audited party).

NOTE 3 ISO/IEC 12207 identifies specific software work products (and results of an activity) to be audited.

Base Practices:

SUP.7.BP1 : Develop and implement audit strategy. Develop and implement audit strategy specifying the criteria for compliance with the requirements, plans, and contract as appropriate.

SUP.7.BP2 : Plan an audit. For planning an audit, the following items should be prepared:

- scope of audit;
- topics for audit;
- attendees;
- responsibilities of attendants;
- entry and exit criteria for the audit;
- a schedule;
- resource requirement.

SUP.7.BP3 : Audit software development activities. Conduct audits at predetermined milestones to ensure:

- contract meets organization's requirements;
- system specification meets customer's requirements;
- design conforms with specification;
- software products reflect the design documents;
- testing coverage meets quality assurance requirements;
- software product quality reached organization's standards;
- documentation complies with managerial and customer's requirements.

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SUP.7.BP4 : Audit management activities. Conduct audits at predetermined milestones on management activities to ensure:

- proposal against requirements;
- achievement against project plan and schedule;
- risks control;
- compliance with appropriate standards;

SUP.7.BP5 : Audit process performance. Conduct audits at predetermined milestones on process performance to ensure the suitability and capability of the current processes for a project.

SUP.7.BP6 : Audit final products and system. Audit the final system to ensure that completeness and correctness of configuration and functionality complies with appropriate standards and specifications, and satisfies the acceptance criteria documented in the contract.

SUP.7.BP7 : Identify corrective actions from the audit report. Analyze audit report; distribute audit report; document proposed resolution(s) for audit results; determine priority for actions for resolutions.

SUP.7.BP8 : Track actions for audit report. Track actions for resolutions of identified problems by audit; report and document changes of work products and processes.

5.2.1.8 SUP.8 Problem resolution process

Basic process

The purpose of the *Problem resolution process* is to ensure that all discovered problems are analyzed and resolved and that trends are recognized. As a result of successful implementation of the process:

— the problem resolution activities will be identified to ensure that all discovered problems are analyzed and resolved;

— problem reports will be prepared upon detection of problems (including non-conformances) in a software product or activity;

— a mechanism will be provided for recognizing and acting on trends in problems identified.

NOTE The process supports performance of the process attributes 2.1 and 2.2 in those instances where it is invoked.

Base Practices:

SUP.8.BP1 : Establish problem report system. A problem report system should be established to ensure problems and divergences can be detected, described, recorded, analyzed, corrected and prevented in every process.

SUP.8.BP2 : Prioritize problems. Prioritize problems according to the cause, range and severity level described in problem reports.

SUP.8.BP3 : Determine actions for problems. Analyze problem causes; propose resolution(s); and determine priority for actions.

SUP.8.BP4 : Track actions for problems. Track resolutions of identified problems; notify affected parties; report and document changes of work products and processes.

SUP.8.BP5 : Review and distribute solutions. Distribute corrected component process or system after relevant review and authorization.

SUP.8.BP6 : Analyze problem trends. Collect and analysis data on problem occurrence, detection, affected range, and correction actions at product, process, project and organization levels, in order to identify the trends of problems in practices and processes.

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5.3 Organizational life cycle processes

The **Organizational life cycle** processes consist of two process categories:

MAN Management

ORG Organization

5.3.1 Management process category (MAN)

The *Management process category* consists of processes that contain practices of a generic nature that may be used by anyone who manages any type of project or process within a software life cycle.

The processes belonging to the Management process category are:

MAN.1 Management Process

MAN.2 Project Management Process

MAN.3 Quality Management

MAN.4 Risk Management

5.3.1.1 MAN.1 Management process

Basic process

The purpose of the *Management process* is to organize, monitor, and control the initiation and performance of any processes or functions within the organization to achieve their goals and the business goals of the organization in an effective manner. As a result of successful implementation of the process:

— the activities and tasks that must be performed to achieve the purpose of the process or function will be identified;

— the feasibility of achieving process goals with available resources and constraints will be evaluated;

— the resources and infrastructure required to perform the identified activities and tasks will be established;

— activities will be identified and tasks will be implemented;

— performance of the defined activities and tasks will be monitored;

— work products resulting from the process activities will be reviewed and results analyzed and evaluated;

— action will be taken to modify the performance of the process or function when performance deviates from the identified activities and tasks or fails to achieve their goals;

— successful achievement of the purpose of the process or function will be demonstrated.

NOTE This process supports performance of the process attributes 2.1 and 2.2 in those instances where it is invoked.

Base Practices:

MAN.1.BP1 : Identify activities and tasks. Identify the activities and tasks that have to be performed to achieve the purpose of the process or function and establish meaningful milestones.

MAN.1.BP2 : Evaluate feasibility of achieving process. Evaluate the feasibility of achieving process with available resources and constraints.

MAN.1.BP3 : Plan and allocate resources and infrastructure. Plan and allocate the resources and infrastructure required to perform the identified activities and tasks according to a defined time schedule.

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MAN.1.BP4 : Implement activities. Implement activities and tasks by assigning clear responsibilities to individuals.

MAN.1.BP5 : Monitor performance. Regularly monitor performance of the defined activities and tasks with respect to achievement of the established milestones within the defined cost and time constraints.

MAN.1.BP6 : Review work products and evaluate results. Review work products for completeness and quality; analyse and evaluate results.

MAN.1.BP7 : Take action on performance deviation. Take appropriate action to modify performance of the process or function when performance deviates from what is expected; adjust and update plans accordingly.

MAN.1.BP8 : Demonstrate successful achievement. Demonstrate successful achievement of the purpose of the process or function by using quantitative or qualitative evidence.

5.3.1.2 MAN.2 Project management process

New process

The purpose of the *Project management process* is to identify, establish, coordinate and monitor activities, tasks and resources necessary for a project to produce a product and/or service meeting the requirements. As a result of successful implementation of the process:

— the scope of the work for the project will be defined;

— the feasibility of achieving the goals of the project with available resources and constraints will be evaluated;

— the tasks and resources necessary to complete the work will be sized and estimated;

— interfaces between elements in the project, and with other projects and organizational units, will be identified and monitored;

— plans for execution of the project will be developed and implemented;

— progress of the project will be monitored and reported;

— actions to correct deviations from the plan and to prevent recurrence of problems identified in the project will be taken when project targets are not achieved.

NOTE This process supports performance of the process attribute 2.1 in those instances where it is invoked.

Base Practices :

MAN.2.BP1 : Define the scope of work. Define the work to be undertaken by the project, and determine that achievement of the goals of the project is feasible with available resources and constraints.

NOTE For the identification of quality goals see MAN.3.BP1.

MAN.2.BP2 : Determine development strategy. Evaluate options available for achieving the goals of the project, and determine, on the basis of risks and opportunities, which strategy will be adopted.

MAN.2.BP3 : Select software life cycle model. Select a software life cycle model for the project which is appropriate to the scope, magnitude and complexity of the project.

NOTE This base practice is related to MAN.2.BP1.

MAN.2.BP4 : Size and estimate tasks and resources. Size and estimate tasks and resources necessary to complete the work by evaluating the options available for achieving the goals of the project and by taking into consideration existing risks and opportunities.

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NOTE 1 This implies for projects involving the development of software that a development strategy is determined, a software life cycle model which is appropriate to the scope, magnitude and complexity of the project is selected, and what is needed for the entire software life cycle to satisfy the software requirements is estimated.

NOTE 2 For the identification of existing risks see MAN.4.BP2.

MAN.2.BP5 : Develop work breakdown structure. Develop a work break down structure incorporating project tasks, deliverables and sequence and relating these to the resources required to accomplish them and to the strategy to be followed.

MAN.2.BP6 : Identify infrastructure requirements. Identify and select the environmental and human resource elements needed to support the project strategy and performance.

MAN.2.BP7 : Establish project schedule. Establish the project schedule, based on the work breakdown structure, estimates, and infrastructure elements.

MAN.2.BP8 : Allocate responsibilities. Identify the specific individuals and groups contributing to, and impacted by, the project, allocate them their specific responsibilities, and ensure that the commitments are understood and accepted, funded and achievable.

MAN.2.BP9 : Identify interfaces. Identify and monitor the efficiency of interfaces between elements in the project and with other projects and organizational units.

MAN.2.BP10 : Establish and implement project plans. Provide a mechanism to ensure that project plans are formally developed, implemented and maintained, and available to those involved with the project. Document the results of the activities in this process within the project plans, and ensure that the plans are published to all those involved.

MAN.2.BP11 : Track progress against plans. Regularly compare and report the status of the project against the project plans. Use disciplined approaches to regularly evaluate the performance of the project. Methods and techniques which can be applied include:

- metrics,
- technical and managerial reviews,
- assessment of established quality and performance criteria.

NOTE For the establishment and assessment of quality criteria see MAN.3, *Quality management process*. For the evaluation of risks see MAN.4, *Risk management process*.

MAN.2.BP12 : Act to correct deviations. Take action when project targets are not achieved, to correct deviations from the plan and to prevent recurrence of problems identified in the project. Update project plans accordingly.

5.3.1.3 MAN.3 Quality management process

New process

The purpose of the *Quality management process* is to monitor the quality of the project's products and/or services and to ensure that they satisfy the customer. The process involves establishing a focus on monitoring the quality of product and process at both the project and organizational level. As a result of successful implementation of the process:

— quality goals based on the customer's stated and implicit quality requirements will be established for various checkpoints within the project’s software life cycle;

— an overall strategy will be developed to achieve the defined goals;

— identified quality control and assurance activities will be performed and their performance confirmed;

— actual performance against the quality goals will be monitored;

— appropriate action will be taken when quality goals are not achieved.

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NOTE 1 This process supports performance of the process attributes 4.1 and 4.2 in those instances where it is invoked.

NOTE 2 This process goes beyond the quality control and assurance activities performed in *Quality assurance process* (SUP.3), to provide an overall approach to meeting the stated and implicit requirements of the customer.

Base Practices :

MAN.3.BP1 : Establish quality goals. Based on the customer's stated and implicit requirements for quality, establish quality goals for the product and process that can be evaluated throughout the project, preferably in a quantitative manner.

NOTE For projects involving the development of software quality goals are established for various checkpoints within the project's software life cycle.

MAN.3.BP2 : Define overall strategy. Develop an overall strategy at the project and organizational level to achieve the defined goals by defining the metrics that will measure the results of project activities and by defining acceptance criteria that will help to assess whether the relevant quality goals have been achieved.

MAN.3.BP3 : Identify quality activities. For each quality goal, identify quality control and assurance activities which will help achieve and monitor that quality goal, both at the project and organizational level.

NOTE For projects involving the development of software these activities are integrated within the project's software life cycle, see also the SUP.3 Base Practices.

MAN.3.BP4 : Perform quality activities. Perform the identified quality assurance and control activities and confirm their performance.

MAN.3.BP5 : Assess quality. Throughout the project and at least at the identified checkpoints within the project's software life cycle, apply the defined quality metrics to assess whether the relevant quality goals have been achieved.

MAN.3.BP6 : Take corrective action. When defined quality goals are not achieved, take corrective or preventive action both at the project and organizational level.

NOTE The corrective action can involve fixing the product generated by a particular project activity or changing the planned set of activities in order to better achieve the quality goals or both. The preventive action can involve modifying product specifications or process definitions, or both, to prevent recurrence of the non-achievement.

5.3.1.4 MAN.4 Risk management process

New process

The purpose of the *Risk management process* is to identify and mitigate the project risks continuously throughout the life-cycle of a project. The process involves establishing a focus on monitoring of risks at both the project and organizational levels. As a result of successful implementation of the process:

— the scope of the risk management to be performed for the project will be determined;

— appropriate risk management strategies will be defined and implemented;

— risks to the project will be identified in the project strategy, and as they develop during the conduct of the project;

— the risks will be analyzed and the priority in which to apply resources to monitor these risks will be determined;

— risk metrics will be defined, applied, and assessed to determine the change in the risk state and the progress of the monitoring activities;

— appropriate action will be taken to correct or avoid the impact of risk.

NOTE This process supports performance of the process attribute 2.1 in those instances where it is invoked.

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Base Practices :

MAN.4.BP1 : Establish risk management scope. Determine the scope of risk management to be performed for the project, in accordance with organizational risk management policies.

NOTE Issues to be considered include the severity, probability, and type of risks to identify and manage.

MAN.4.BP2 : Identify risks. Identify risks to the project both initially within the project strategy and as they develop during the conduct of the project.

NOTE Examples of risks include cost, schedule, effort, resource, and technical risks.

MAN.4.BP3 : Analyze and prioritize risks. Assess the probability of occurrence, impact, time-frame, causes and interrelationships of risks for determining the priority in which to apply resources to mitigate these risks.

MAN.4.BP4 : Define risk management strategies. Define appropriate strategies to manage each risk or set of risks, both at the project and organizational level.

MAN.4.BP5 : Define risk metrics. For each risk (or set of risks) define the metrics that measure the change in the risk state and the progress of mitigation activities.

NOTE Metrics should cover changes in the probability, impact and time-frame of risks

MAN.4.BP6 : Implement risk management strategies. Carry out the defined management strategies both at the project and organizational level.

MAN.4.BP7 : Assess results of risk management strategies. At identified checkpoints, apply the defined metrics to assess the expected progress and level of success of the risk management strategies.

MAN.4.BP8 : Take corrective action. When expected progress in risk mitigation is not achieved, take appropriate corrective action to correct or avoid the impact of risk.

NOTE Corrective action may involve developing and implementing new mitigation strategies or adjusting the existing strategies.

5.3.2 Organization process category (ORG)

The *Organization process category* consists of processes that establish the business goals of the organization and develop process, product, and resource assets which, when used by the projects in the organization, help the organization achieve its business goals. Although organizational operations in general have a much broader scope than that of software process, software processes are implemented in a business context and, to be effective, require an appropriate organizational environment. Taken together, these organizational processes:

— build organizational infrastructure;

— take advantage of the best of what is available(best practices) in any one part of the organization (effective processes, advanced skills, quality code, good support tools);

— make the organizational best practices available to the entire organization;

— provide a basis for continuous improvement across the organization.

The processes belonging to the Organization process category are:

ORG.1 Organizational alignment process

ORG.2 Improvement process

ORG.2.1 Process establishment process

ORG.2.2 Process assessment process

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ORG.2.3 Process improvement process

ORG.3 Human Resource Management process

ORG.4 Infrastructure process

ORG.5 Measurement Process

ORG.6 Reuse Process

5.3.2.1 ORG.1 Organizational alignment process

New process

The purpose of the *Organizational alignment process* is to ensure that the individuals in the organization share a common vision, culture and understanding of the business goals to empower them to function effectively. Although business re-engineering and Total Quality Management have a much broader scope than that of software process, software process improvement occurs in a business context and, to be successful, must address business goals. As a result of successful implementation of the process:

— a vision, mission, goals and objectives for the business will be made known to all employees;

— everyone in the organization understands their role in achieving the goals of the business and is able to perform that role.

NOTE 1 The process is outside the scope of ISO/IEC 12207. Some reasons are:

- The issue of overall business culture is beyond the scope of ISO/IEC 12207.
- The tailoring process and the guidance on tailoring and relations between processes and organizations presented in the ISO/IEC 12207 annexes address some of the issues related to the *Organizational alignment process*;
- From the perspective of ISO/IEC 12207, the ramifications of implementation of the *Organizational alignment process* are implicit and expected to be built into the contract for any specific project.

NOTE 2 This process supports performance of the process attributes 4.1 and 5.2 in those instances where it is invoked.

Base Practices:

ORG.1.BP1 : Develop a strategic vision. Develop a strategic vision for the organization that identifies the relationship of software engineering functions to the core activities of the organization and its long term goals.

ORG.1.BP2 : Deploy vision. Deploy the organization strategic vision to all individuals working for the organization, using appropriate management and communication mechanisms.

ORG.1.BP3 : Develop a quality culture. Define quality policies and initiatives that are convergent with the business goals of the organisation; disseminate quality policies and initiatives.

ORG.1.BP4 : Build and empower teams. Create teams and empower them to work with an integrated product perspective with a primary goal of customers satisfaction.

ORG.1.BP5 : Provide incentives. Provide incentives to team members to contribute to the strategy of the organization.

5.3.2.2 ORG.2 Improvement process

Basic process

The purpose of the *Improvement process* is to establish, assess, measure, control and improve a software life cycle process. As a result of successful implementation of this process:

— a set of organizational process assets will be developed and made available;

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— the organization's process capability will be assessed periodically to determine the extent to which process implementation is effective in achieving the organization's goals;

— the effectiveness and efficiency of the organization's processes with respect to business goal achievement will be improved on an ongoing basis.

Base Practices:

ORG.2.BP1 : Define organizational processes. Define, document and maintain a set of process descriptions.

ORG.2.BP2 : Deploy the processes. Deploy the standard processes by involving the whole organisation and initiating quality improvement projects or activities.

ORG.2.BP3 : Assess the deployed processes. Assess the deployed processes on a regular basis to determine the extent to which process implementation is effective in achieving the organization's goals.

ORG.2.BP4 : Improve the standard processes. Based on the results of assessments, improve the set of standard process descriptions.

5.3.2.3 ORG.2.1 Process establishment process

Component process of ORG.2 - Improvement process

The purpose of the *Process establishment process* is to establish a suite of organizational processes for all software life cycle processes as they apply to its business activities. As a result of successful implementation of the process:

— a defined and maintained standard set of processes will be established, along with an indication of each process's applicability;

— the detailed tasks, activities and associated work products of the standard process will be identified, together with expected performance characteristics;

— a strategy for tailoring the standard process for the product or service will be developed in accordance with the needs of the project;

— information and data related to the use of the standard process for specific projects will exist and be maintained.

NOTE This process supports performance of the process attribute 3.1 in those instances where it is invoked.

Base Practices:

ORG.2.1.BP1 : Define goals. Define the process goals that are to be achieved by following the process in the organization.

NOTE - One input to defining the goals is the organizations strategic vision.

ORG.2.1.BP2 : Identify activities, roles, authorities & responsibilities. Identify the activities that comprise the way the process is currently and/or should be performed and identify the roles, authorities and responsibilities for these activities.

ORG.2.1.BP3 : Define and document the processes performed in the organization. Define and document the processes that are performed in the organization by identifying and describing :

- inputs and outputs for the process;
- entry and exit criteria for entering and exiting the process;
- control points in the process where key reviews and decisions are made;
- external interfaces with related processes, which supply inputs and consume outputs;
- internal dependencies between the activities in the process;

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- process measures for the process that can be used to demonstrate achievement of the process goals.

ORG.2.1.BP4 : Establish organisational policies. Establish written organisational policies for using the organization's standard process family; establish written guide-lines for tailoring the organization's standard process family to meet the specific needs of projects.

ORG.2.1.BP5 : Establish performance expectations. Establish expectations for process performance when using the organizations standard process family.

ORG.2.1.BP6 : Deploy the process. Deploy the organizations standard process family available throughout the organization.

ORG.2.1.BP7 : Check the standard processes deployment. Control the deployment of the standard process family within the organization.

ORG.2.1.BP8 : Capture process data. Capture information and data related to the use of standard processes; maintain the collected data.

ORG.2.1.BP9 : Maintain the standard processes. Maintain the standard process description.

5.3.2.4 ORG.2.2 Process assessment process

Component process of ORG.2 - Improvement process

The purpose of the *Process assessment process* is to determine the extent to which the organization's standard software processes contribute to the achievement of its business goals and to help the organization focus on the need for continuous process improvement. As a result of successful implementation of the process:

— an efficient and effective process assessment method will exist to determine the current capability of the organization and its processes to produce products and services consistent with its business goals;

— the relative strengths and weaknesses of the organization's standard software processes will be understood;

— accurate and accessible assessment records will be kept and maintained;

— reviews of the organization's standard processes will be carried out at appropriate intervals to ensure their continuing suitability and effectiveness in light of assessment results.

NOTE ISO/IEC TR 15504-3 defines an approach to the performance of this process

Base Practices:

ORG.2.2.BP1: Determine the assessment method. Define the method to be used to perform the assessment.

ORG.2.2.BP2: Define assessment goals. Define and validate the assessment goals and identify the criteria to verify the achievement of the goals.

ORG.2.2.BP3: Define the assessment inputs. Define the assessment inputs including the assessment scope, the processes to be investigated within the defined organisational unit, the highest level to be investigated, the organisational unit which deploys these processes, the process context, the assessment constraints and the assessment model.

ORG.2.2.BP4: Plan the assessment. Plan the assessment process, specifying the required inputs, the activities to be performed in conducting the assessment, the resources and schedule assigned to these activities, the selection and defined responsibilities of the assessors and organization participants in the assessment.

ORG.2.2.BP5: Perform the assessment to collect data. Perform the assessment to collect the data required for evaluating the processes within the scope of the assessment in a systematic and ordered manner.

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ORG.2.2.BP6: Validate the data. Validate the data collected as appropriate, ensuring that the validated data sufficiently covers the assessment goal.

ORG.2.2.BP7: Identify strengths and weaknesses. Identify the relative strengths and weaknesses of the organization unit's processes by using the collected data.

ORG.2.2.BP8: Maintain the assessment results. Maintain accurate and current assessment results in an accessible location and format.

ORG.2.2.BP9: Exploit the assessment result. Exploit the assessment results to maintain the organization's standard processes.

ORG.2.2.BP10: Report the assessment result. Report and document the assessment results to each individual concerned.

NOTE - The assessment results should include at minimum the outputs specified in Clause 4.5 ISO/IEC TR 15504-3.

5.3.2.5 ORG.2.3 Process improvement process

Component process of ORG.2 - Improvement process

The purpose of the *Process improvement process* is to continually improve the effectiveness and efficiency of the processes used by the organization in line with the business need. As a result of successful implementation of the process:

— changes to standard and defined processes will be made in a controlled way, with predictable results;

— the organization will effect improvements to its processes through activities such as process assessment and review;

— monitored software process improvement activities will be implemented in a coordinated manner across the organization;

— historical, technical and evaluation data will be analyzed and used to improve these processes, to recommend changes in projects, and to determine technology advancement needs;

— quality cost data will be collected, maintained, and used to improve the organization's processes as a monitoring activity, and to serve to establish the cost of prevention and resolution of problems and non-conformity in software products and services.

NOTE This process supports performance of the process attributes 5.1 and 5.2 in those instances where it is invoked.

Base Practices:

ORG.2.3.BP1 : Identify improvement opportunities. Identify opportunities for software process improvement.

ORG.2.3.BP2 : Define scope of improvement activities. Define the purpose, objectives, scope, and priorities of the process improvement activities in accordance with the business goals of the organization.

ORG.2.3.BP3 : Understand the process. Assess the process to understand its strengths and weaknesses.

ORG.2.3.BP4 : Identify improvements. Identify where the process needs to be improved to achieve its process goals.

ORG.2.3.BP5 : Prioritize improvements. Prioritize the improvements which can be made in the process based on an analysis of the impact of potential improvements on achieving the goals of the process.

ORG.2.3.BP6 : Define measures of impact. Define measures that can be used to determine the impact of the process changes on achieving the process's goals.

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ORG.2.3.BP7 : Change the process. Change the process in line with the improvements that have been identified.

ORG.2.3.BP8 : Confirm the improvement. Pilot test changes to confirm that they improve the process based on analysis of appropriate data.

ORG.2.3.BP9 : Deploy improvement. Deploy improved processes across the organization as appropriate.

5.3.2.6 ORG.3 Human resource management process

Extended process

The purpose of the *Human resource management process* is to provide the organization and projects with individuals who possess skills and knowledge to perform their roles effectively and to work together as a cohesive group. As a result of successful implementation of the process:

— the roles and skills required for the operations of the organization and the project will be identified through timely review of the organizational and project requirements;

— training will be identified and conducted to ensure that all individuals have the skills required to perform their assignments, using mechanisms such as training strategies and materials;

— individuals with the required skills and competencies will be identified and recruited using mechanisms such as procedures, or they will be trained as appropriate to perform the organizational and project roles;

— effective interaction between individuals and groups will be supported;

— the work force will have the skills to share information and coordinate their activities efficiently;

— objective criteria will be defined against which group and individual performance can be monitored to provide performance feedback and to enhance performance.

NOTE This process supports performance of the process attribute 3.2 in those instances where it is invoked.

Base Practices:

ORG.3.BP1 : Identify human resource needs. Identify needs for human resources across the organization based on organizational and project inputs to build the knowledge and skills of the staff. These needs may be met through training, recruitment or other staff development mechanisms.

ORG.3.BP2 : Develop or acquire training. Develop or acquire training that addresses the common training needs.

ORG.3.BP3 : Train personnel. Train personnel to have the knowledge and skills needed to perform their roles.

ORG.3.BP4 : Recruit qualified staff. Establish a systematic program for recruitment of staff qualified to meet the needs of the organization, while providing opportunities for career development for existing staff.

ORG.3.BP5 : Define evaluation criteria. Define objective criteria that can be used to assess staff performance.

ORG.3.BP6 : Evaluate staff performance. Evaluate the performance of staff, either individually or in groups, in respect of their contributions to the goals of the organization as a whole. Ensure that feed-back is discussed with the staff.

ORG.3.BP7 : Provide feedback on performance. Ensure that feedback is provided to staff on the results of any performance evaluations performed.

ORG.3.BP8 : Maintain staff records. Maintain adequate records of staff, including not only personnel details, but also information on skills, training completed, and performance evaluations.

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ORG.3.BP9 : Define project teams. Define the teams which will be needed to perform the work of the project, defining the structure and operating rules for the team, required knowledge and skills.

ORG.3.BP10 : Empower project teams. Empower teams to perform their job, by ensuring that they have

- an understanding of their job;
- a shared vision or sense of common interest;
- appropriate mechanisms or facilities for communication and work;
- support from the appropriate management for what they are trying to accomplish;

ORG.3.BP11 : Maintain project team interactions. Obtain and maintain agreement on the implementation of interactions between teams.

5.3.2.7 ORG.4 Infrastructure process

Basic process

The purpose of the *Infrastructure process* is to maintain a stable and reliable infrastructure that is needed to support the performance of any other process. The infrastructure may include hardware, software, methods, tools, techniques, standards, and facilities for development, operation, or maintenance. As a result of successful implementation of the process:

— an infrastructure will be established that is consistent with and supportive of the applicable process procedures, standards, tools and techniques;

— the infrastructure will meet all requirements for functionality, performance, safety, security, availability, space, equipment, cost, time and data integrity.

NOTE This process supports performance of the process attribute 3.2 in those instances where it is invoked.

Base Practices:

ORG.4.BP1 : Identify software engineering environment requirements. Determine requirements for the software engineering environment, identifying :

- process roles and activities it should support;
- security issues it should address;
- throughput and data sharing requirements;
- backup and recovery;
- remote access facility.

ORG.4.BP2 : Provide a software engineering environment. Acquire and provide a software engineering environment which satisfies the requirements.

ORG.4.BP3 : Provide support for individuals using the software engineering infrastructure. Analyse and specify support requirements; provide support for those who utilize the software engineering environment.

ORG.4.BP4 : Maintain software engineering environment. Perform maintenance on the software engineering environment for the purposes of :

- correcting defects;
- improving performance;
- modifying the environment to keep up with changes in the process activities and tools it supports;
- controlling changes to enable regression if necessary.

ORG.4.BP5 : Provide a workspace conductive to productive performance. Provide a workspace, with appropriate furnishings and office equipment, that encourages productive performance.

ORG.4.BP6 : Ensure data integrity and security. Provide the means to ensure that data resulting from project or process activities are protected from loss, corruption or damage.

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ORG.4.BP7 : Provide remote access facility. Provide the software project's technical and managerial staff with the means to access their work environment and data from a remote location, as appropriate.

5.3.2.8 ORG.5 Measurement Process

New process

The purpose of the *Measurement process* is to collect and analyze data relating to the products developed and processes implemented within the organizational unit, to support effective management of the processes, and to objectively demonstrate the quality of the products. As a result of successful implementation of the process:

— an appropriate set of measurements driven by the project and organizational goals will be identified;

— data required will be collected and analyzed;

— a collection of historical data relating to process implementation will be established and maintained;

— measurements will be used to support decisions and provide an objective basis for communication between the interested parties.

NOTE 1 The process supports performance of the process attributes 4.1 and 4.2 in those instances where it is invoked.

NOTE 2 This process is closely linked to the *Project management process* (MAN.2).

Base Practices:

ORG.5.BP1 : Establish metrics for process management. Establish measurable metrics for processes measurement and enable data to be collected and analyzed against the metrics.

ORG.5.BP2 : Establish metrics for the quality of work products. Establish measurable metrics for work products quality and enable data to be collected and analyzed against the metrics.

ORG.5.BP3 : Conduct quantitative process management. Conduct quantitative process management based on quantitative metrics, benchmarks or statistical data.

ORG.5.BP4 : Measure the quality of work products. Measure work products quality based on established metrics, benchmarks, or statistical data.

ORG.5.BP5 : Make measurement data available for decision-making. Maintain accurate and current measurement data and make it accessible for any decision making processes for which it is relevant.

ORG.5.BP6 : Define benchmark. Define a set of benchmark that will be used to benchmark the organization's processes.

ORG.5.BP7 : Benchmark processes. Compare measured processes against benchmark processes to determine gaps between processes; apply defined process improvement practices to narrow any gap.

5.3.2.9 ORG.6 Reuse process

New process

The purpose of the *Reuse process* is to promote and facilitate the reuse of new and existing software work products from an organizational and product/project perspective. As a result of successful implementation of the process:

— reuse strategies will be defined;

— reuse activities will be identified and established;

— a reuse infrastructure (e.g., networks, configuration management, repositories, etc.) will be established and maintained.

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Base Practices:

ORG.6.BP1 : Define organizational reuse strategy. Identify, develop and apply reusable entities at all organizational levels and in applicable processes to improve productivity and quality.

ORG.6.BP2 : Establish reuse library. Establish an accessible library system for collection, categorization, management, maintenance, control, and update of reusable entities.

ORG.6.BP3 : Identify reusable entities. Identify reusable entities such as code modules, tests, interfaces, frameworks, documents, processes, experiences, domain knowledge and external resources.

ORG.6.BP4 : Develop reusable entities. Development of reusable work products, such as code modules, tests, interfaces, frameworks, documents and domain knowledge.

ORG.6.BP5 : Keep reusable entities stable and consistent. Maintain consistency, stability and standardization of reusable entities in the reuse library.

ORG.6.BP6 : Report and certify reusable entities and domain knowledge. Report and certify reusable entities and domain knowledge and experience.

ORG.6.BP7 : Inform potential users about reusable entities and domain knowledge. Notify the existence and features of new reusable entities and domain knowledge to potential users.

6 The capability dimension

This clause presents the management practices related to the process attributes and capability levels defined in the process capability dimension of the reference model in ISO/IEC TR 15504-2. Management practices with their associated characteristics are the indicators of process capability and are the means of achieving the capabilities addressed by process attributes. Evidence of management practice performance supports the judgement of the degree of achievement of the process attribute. Management practices are associated with (annex B) :

— practice performance characteristics that provide guidance on the implementation of the practice;

— resource and infrastructure characteristics that provide mechanisms for assisting in the management of the process; and

— associated processes from the process dimension that support the management practice.

Specific management practices are linked to each process attribute as shown in this clause (clause 6). The set of management practices is intended to be applicable to all processes in the process dimension of the model. The indicators of process capability (defined in annex B) help to establish objective evidence that the management practices associated with the process attribute are being performed.

The capability dimension of the model consists of six capability levels matching the capability levels in the reference model in ISO/IEC TR 15504-2.

6.1 Level 0: Incomplete process

The process is not implemented, or fails to achieve its process outcomes.

At this level there is little or no evidence of any systematic achievement of any of the defined attributes.

6.2 Level 1: Performed process

The implemented process achieves its process outcomes.

The following attribute of the process demonstrates the achievement of this level:

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6.2.1 PA 1.1 Process performance attribute

The extent to which the process achieves the process outcomes by transforming identifiable input work products to produce identifiable output work products. As a result of full achievement of this attribute:

— the scope of work to be performed and work products to be produced are understood;

— work products will be produced that support the achievement of the process outcomes.

The related Management Practices are:

MP 1.1.1 **Identify** input and output work products.

MP 1.1.2 **Ensure that the scope of work is identified** for process execution and for the work products to be used and produced by the process.

MP 1.1.3 **Ensure that base practices are implemented,** producing work products which support the achievement of the defined process outcomes.

6.3 Level 2: Managed process

The previously described *Performed process* now executes in a managed fashion (planned, tracked, verified and adjusted) based upon defined objectives.

The following attributes of the process demonstrate the achievement of this level:

6.3.1 PA 2.1 Performance management attribute

The extent to which the performance of the process is managed to produce work products that meet the defined objectives. As a result of full achievement of this attribute:

— the objectives for the performance of the process will be identified (e.g. quality, time-scale, cycle time and resource usage);

— the responsibility and authority for developing the work products of the process will be assigned;

— the performance of the process will be managed to produce work products that meet the defined objectives.

The related Management Practices are:

MP 2.1.1 **Identify the objectives** for the performance of the process (for example, time-scale, cycle time and resource usage).

MP 2.1.2 **Plan the performance of the** process according to the identified objectives by identifying the activities of the process, the expected time schedule and allocation of resources for each activity.

MP 2.1.3 **Plan and assign the responsibility and authority** for developing the work products of the process.

MP 2.1.4 **Manage the execution of the activities** by continued tracking and re-planning to produce work products that meet the defined objectives.

6.3.2 PA 2.2 Work product management attribute

The extent to which the performance of the process is managed to produce work products that are appropriately documented, controlled and verified. As a result of full achievement of this attribute:

— the requirements (functional and non-functional) of the specified work products of the process will be defined;

— the requirements for the documentation and control of the work products will be defined;

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— the dependencies among the controlled work products will be identified;

— work products will be appropriately identified and documented, and changes will be controlled.;

— the work products will be verified and adjusted to meet the defined requirements.

The related Management Practices are:

MP 2.2.1 **Identify the requirements** for the work products, including both functional and non-functional aspects.

MP 2.2.2 **Manage** the documentation, configuration management and change control of the work products.

MP 2.2.3 **Identify and define** any work product dependencies.

MP 2.2.4 **Manage the quality of work** products to ensure that they meet their functional and non-functional requirements.

6.4 Level 3: Established process

The previously described *Managed process* now performs using a defined process that is based upon software engineering principles and capable of achieving its process outcomes.

The following attributes of the process demonstrate the achievement of this level:

6.4.1 6PA 3.1 Process definition attribute

The extent to which the performance of the process uses a process definition based upon a standard process to achieve the process outcomes. As a result of full achievement of this attribute:

— a standard process including appropriate guidance on tailoring will be defined, that supports the execution of the managed process;

— performance of the process will be conducted in accordance with appropriately selected and/or tailored standard process documentation;

— historical process performance data will be gathered to establish and refine the understanding of the process behaviour (e.g. in order to estimate the process performance resource needs);

— experiences of using the defined process will be used to refine the standard process.

The related Management Practices are:

MP 3.1.1 **Identify the standard process** that supports the execution of the managed process and provides documented guidance on tailoring.

MP 3.1.2 **Implement and/or tailor the standard process** to obtain a defined process appropriate to the process context.

MP 3.1.3 **Gather process performance data** so that the behaviour of the defined process can be understood.

MP 3.1.4 **Establish and refine the understanding of the process behaviour** by using process performance data.

MP 3.1.5 **Refine** the standard process.

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6.4.2 PA 3.2 Process resource attribute

The extent to which the process draws upon suitable resources (for example, human resources and process infrastructure) that is appropriately allocated to deploy the defined process. As a result of full achievement of this attribute:

— roles, responsibilities and competencies required for performing the process will be identified and documented;

— the process infrastructure required for performing the process will be identified and documented;

— the required resources will be available, allocated and used to support the performance of the defined process.

The related Management Practices are:

MP 3.2.1 **Identify and document the roles, responsibilities and competencies** required to support the implementation of the defined process.

MP 3.2.2 **Identify and document the process infrastructure requirements** to support the implementation of the defined process.

MP 3.2.3 **Provide, allocate and use the resources** to support the performance of the defined process.

MP 3.2.4 **Provide, allocate and use an adequate process infrastructure** to support the performance of the defined process.

6.5 Level 4: Predictable process

The previously described *Established process* now performs consistently within defined limits to achieve its process outcomes.

The following attributes of the process demonstrate the achievement of this level:

6.5.1 PA 4.1 Measurement attribute

The extent to which product and process goals and measures are used to ensure that performance of the process supports the achievement of the defined goals in support of the relevant business goals. As a result of full achievement of this attribute:

— product and process goals and measures will be identified in line with relevant business goals;

— product and process measures will be collected to monitor the extent to which the defined goals are met;

— process performance trends across the organization will be analyzed;

— process capability will be measured and maintained across the organization.

The related Management Practices are:

MP 4.1.1 **Identify product and process goals and measures** which support the achievement of the relevant business goals.

MP 4.1.2 **Collect the specified product and process measures** through performing the defined process.

MP 4.1.3 **Analyze trends in the performance of the process** across the organisation.

MP 4.1.4 **Measure the process capability** and maintain it within the defined limits across the organisation.

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6.5.2 PA 4.2 Process control attribute

The extent to which the process is controlled through the collection, analysis, and use of product and process measures to correct, where necessary, the performance of the process to achieve the defined product and process goals. As a result of full achievement of this attribute:

— suitable analysis and control techniques will be identified;

— in-process product and process measures will be collected and analyzed to support control of process performance within defined limits;

— process performance will be managed quantitatively.

The related Management Practices are:

MP 4.2.1 **Identify suitable measurement techniques,** appropriate to the process context, to support process and product improvement.

MP 4.2.2 **Collect measures and identify process control parameters** in order to perform analysis.

MP 4.2.3 **Control the process performance using the analysis measures** to identify actions to maintain control and/or implement improvement.

6.6 Level 5: Optimizing process

The previously described *Predictable process* now dynamically changes and adapts to meet relevant current and projected business goals effectively.

The following attributes of the process demonstrate the achievement of this level:

6.6.1 PA 5.1 Process change attribute

The extent to which changes to the definition, management and performance of the process are controlled to achieve the relevant business goals of the organization. As a result of full achievement of this attribute:

— the impact of all proposed changes will be assessed against the defined product and process goals of the defined and standard processes;

— the implementation of all agreed changes will be managed to ensure that any disruption to the process performance is understood and acted upon;

— the effectiveness of process change on the basis of actual performance will be evaluated against the defined product and process goals and adjustments made as needed.

The related Management Practices are:

MP 5.1.1 **Identify changes to the standard process definition** on the basis of a quantitative understanding of the process.

MP 5.1.2 **Assess the impact of all proposed changes** against the defined product and process goals of the defined and standard processes.

MP 5.1.3 **Define an implementation strategy for the approved change,** ensuring that any disruption to the process performance is understood and acted upon.

MP 5.1.4 **Implement the approved changes** to the affected processes according to the implementation strategy.

MP 5.1.5 **Evaluate the effectiveness of process change** on the basis of actual performance against the defined product, process and business goals, making adjustments as needed.

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6.6.2 PA 5.2 Continuous improvement attribute

The extent to which changes to the process are identified and implemented to ensure continuous improvement in the fulfilment of the relevant business goals of the organization. As a result of full achievement of this attribute:

— the process improvement goals for the process will be defined that support the relevant business goals of the organization;

— the sources of real and potential problems will be identified;

— improvement opportunities will be identified;

— an implementation strategy will be established and deployed to achieve the process improvement goals across the organization.

The related Management Practices are:

MP 5.2.1 **Define the process improvement goals for the process** that support the relevant business goals of the organization.

MP 5.2.2 **Analyse the source of real and potential problems in the current process,** identifying improvement opportunities in a systematic and proactive manner to continuously improve the process.

MP 5.2.3 **Implement changes to selected areas of the tailored process according to the implementation strategy.**

MP 5.2.4 **Validate the effectiveness of process change** on the basis of actual performance against process and business goals add feedback to the standard process definition.

7 Compatibility with the reference model

7.1 Introduction

This part of ISO/IEC TR 15504 sets out an assessment model that is compatible with the reference model in ISO/IEC TR 15504-2. The assessment model can be used in the performance of assessments that meet the requirements of ISO/IEC TR 15504. It may also be used as an example for a model developer.

This clause serves as the statement of conformance of the assessment model to the compatibility requirements explained in ISO/IEC TR 15504-2. For ease of reference, the requirements from Clause 7 of ISO/IEC TR 15504-2 are embedded verbatim in the text of this clause. They should not be construed as normative elements of this part of ISO/IEC TR 15504.

Since this model has been explicitly constructed to be an elaboration of the reference model, the conformance claim is in fact relatively trivial. For other models, particularly ones with a different architecture, the demonstration of conformance may be more difficult requiring more detail in the mapping.

7.2 Model purpose

> *A model shall be based on good software engineering and process management principles and be suitable for the purpose of assessing software process capability.*
>
> [ISO/IEC TR 15504-2, 7.2]

The assessment model in this part of ISO/IEC TR 15504 has been created to be a complete model for the assessment of software process capability, directly compatible with the reference model. The premise is that the capability of processes can be assessed reliably and consistently by judging the indicators of process performance and process capability.

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7.3 Model scope

A model shall encompass all, or a non-empty subset, of the set of processes in the process dimension of the reference model.

A model shall address all, or a continuous subset, of the levels (starting at level 1) of the capability dimension of the reference model for all of the processes within its scope.

It would be permissible for a model, for example, to address solely level 1, or to address levels 1, 2 and 3, but it would not be permissible to address levels 2 and 3 without level 1.

A model shall declare its scope of coverage in the terms of both the process and capability dimensions of the reference model.

[ISO/IEC TR 15504-2, 7.3]

The scope of the assessment model in this part of ISO/IEC TR 15504 is the entire scope of the reference model in ISO/IEC TR 15504-2. Thus in the process dimension, the model provides full coverage of each of the processes in the Customer-Supplier, Engineering, Support, Management and Organization process categories. In the capability dimension, the model addresses the nine process attributes and hence the complete capability level scale from Level 0 to Level 5. As in the reference model, the capability dimension is applicable to each of the processes in the process dimension.

7.4 Model elements and indicators

A model shall be based on a set of elements that explicitly address the purposes, as defined in the reference model, of all the processes within the scope of the model, and that demonstrate the achievement of the process attributes within the capability level scope of the model.

In the process dimension, the detailed elements of the model shall constitute a set of indicators of process performance that focus attention on the effective implementation of processes through their work products.

In the capability dimension, the detailed elements shall constitute a set of indicators of process capability that focus attention on the process management practices that realize the process attributes.

[ISO/IEC TR 15504-2, 7.4]

This assessment model is an elaboration of the reference model : the fundamental elements of the assessment model are the processes and process attributes identical to those in the reference model. The assessment model extends the reference model through the inclusion of assessment indicators as shown in Figure 2. Assessment indicators are :

— base practices, work products and their characteristics ; and

— management practices, practice performance characteristics, resources and infrastructure characteristics

as shown in Figure 2. They support the judgement of the performance and capability of an implemented process.

7.5 Mapping

A model shall provide an explicit mapping from the fundamental elements of the model to the processes and process attributes of the reference model.

The mapping shall be complete, clear, and unambiguous and shall substantiate the declaration of the scope of coverage.

In the process dimension, the mapping shall include the mapping of the indicators of process performance within the model to the purposes of the processes in the reference model.

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In the capability dimension, the mapping shall include the mapping of the indicators of process capability within the model to the definitions of the process attributes in the reference model

The mapping requirement enables assessment models that are structurally different to be related to the reference model.

[ISO/IEC TR 15504-2, 7.4]

The assessment model is constructed as an elaboration of the reference model. Clause 5 (*The process dimension*) and Clause 6 (*The capability dimension*) are structured identically to the process and capability dimensions of the reference model, and hence the fundamental elements have a one to one mapping between the two models.

For each of the process categories and processes of the reference model, Clause 5 repeats the purpose statement of the corresponding reference model process, and then further decomposes the process into base practices.

For each of the process capability levels and process attributes of the reference model, Clause 6 repeats the definitions given in the reference model and then further decomposes each process attribute into management practices.

Therefore, the layout of the model in Clauses 5 and 6 itself provides an explicit mapping of the relationships of the detailed elements of the model to the purpose statements and process attributes of the reference model.

Further decomposition in terms of detailed indicators is included in the Annexes.

7.6 Translation

A compatible model shall provide a formal and verifiable mechanism for converting data collected against the compatible model into a set of process attribute ratings for each reference model process directly or indirectly assessed as defined in 6.7 of this part of ISO/IEC 15504, and in ISO/IEC 15504-3.

[ISO/IEC TR 15504-2, 7.5]

As a consequence of the one to one mapping between the fundamental elements of the assessment model and the reference model, there is no need for translation of the data collected against assessment model into the sets of attribute ratings of the reference model. The process attributes within this assessment model are rated directly using the rating scale in ISO/IEC TR 15504-2.

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Annex A
(informative)

Processes and associated work products

A.1 Introduction

The associated work products listed in this annex may be used when reviewing potential inputs and outputs of an organization's process implementation; these work products are identified with their work product identifier number as used in the Annex C. The associated work products are provided as guidance for potential inputs and outputs to look for, and provide objective evidence supporting the assessment of a particular process. A methodology and assessor judgement are needed to ensure that process context (application domain, business purpose, development methodology, size of the organization, etc.) is explicitly considered to use this information. This list should not be considered as a check-list of what every organization must have but rather as an example and starting point for considering whether, given the context, the work products are necessary and contributing to the intended purpose of the process.

A.2 Primary Life Cycle Processes

A.2.1 Customer Supplier process category (CUS)

CUS.1 - Acquisition Process

Refer to the work products associated with the component processes.

Table A.1 — CUS.1.1 - Acquisition Preparation Process - Associated Work Products

Input		Output	
44)	Product need assessment	31)	Review record
45)	Acquisition strategy	44)	Product need assessment
52)	Requirement specification (Internal)	45)	Acquisition strategy/plan
83)	Customer request record	47)	Request for proposal
		52)	Requirement specification (product / service)
		68)	Acceptance test strategy

Table A.2 — CUS.1.2 - Supplier Selection Process - Associated Work Products

Input		Output	
19)	Meeting minutes	19)	Meeting minutes
22)	Risk analysis record / report	21)	Analysis result
29)	Assessment / audit record	31)	Review record
44)	Product need assessment	47)	Request for proposal
45)	Acquisition strategy	48)	Supplier proposal response
47)	Request for proposal	49)	Supplier history record
48)	Supplier proposal response	50)	Commitments / agreement
49)	Supplier history record	51)	Contract
52)	Requirement specification (product / service)		
87)	Communication mechanism		

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Table A.3 — CUS.1.3 - Supplier Monitoring Process - Associated Work Products

Input		Output	
7)	Work product	19)	Meeting minutes
19)	Meeting minutes	20)	Progress Status record/report
20)	Progress Status record/report	31)	Review record
48)	Supplier proposal response	49)	Supplier history record
51)	Contract	81)	Acceptance record
52)	Requirement specification (internal)	84)	Problem report record
83)	Customer request	95)	Change control record
87)	Communication mechanism	96)	Change history
94)	Change request	97)	Corrective actions
98)	Tracking system	109)	Contract review record
106)	Installation record		
109)	Contract review record		

Table A.4 — CUS.1.4 - Customer Acceptance Process - Associated Work Products

Input		Output	
7)	Work product	19)	Meeting minutes
29)	Assessment audit / record	20)	Progress status record / report
45)	Acquisition strategy / plan	81)	Acceptance record
48)	Supplier proposal response	93)	Configuration item
51)	Contract	94)	Change request
52)	Requirement specification		
68)	Acceptance test strategy		
70)	Release package		
71)	Release (note) information		
83)	Customer request		
95)	Change control record		
109)	Contract review record		

Table A.5 — CUS.2 - Supply process - Associated Work Products

Input		Output	
47)	Request for proposal	31)	Review record
48)	Supplier proposal response	48)	Supplier proposal response
51)	Contract	51)	Contract
52)	Requirement specification (customer)	62)	Test result
68)	Acceptance test strategy / plan	70)	Release package
70)	Release package	71)	Release notes
71)	Release (notes) information	74)	Installation plan
73)	System	75)	Installation guide
76)	Packaging record	78)	Delivery instruction
87)	Communication mechanism	76)	Packaging record
105)	Customer documentation	79)	Delivery record
		80)	Handling and storage guide
		81)	Acceptance record
		106)	Installation record
		109)	Contract review record

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Table A.6 — CUS.3 - Requirements elicitation process - Associated Work Products

Input		Output	
6)	Work breakdown structure	17)	Project plan
21)	Analysis result	31)	Review record
22)	Risk analysis record	44)	Product needs assessment
46)	Market analysis record / report	50)	Commitment / agreement
51)	Contract	52)	Requirement specification (customer)
52)	Requirement specification (customer)	58)	Traceability record/mapping
83)	Customer request	82)	Customer support procedure
87)	Communication mechanism	87)	Communication mechanism
96)	Change history	95)	Change control
		96)	Change history

CUS.4 - Operation Process

Refer to the work products associated with the component processes.

Table A.7 — CUS.4.1 - Operational use process - Associated Work Products

Input		Output	
4)	Job procedure	22)	Risk analysis
40)	Risk measure	42)	Service level measure
41)	Field measure	62)	Test results
42)	Service level measure	84)	Problem report
59)	Test plan	94)	Change request
60)	Test script	99)	Work-around
61)	Test case		
70)	Release package		
71)	Release note		
73)	System		
83)	Customer request		
82)	Customer support procedure		
84)	Problem report		
87)	Communication mechanism		
91)	Configuration management plan		
98)	Tracking system		
103)	Recovery plan		

Table A.8 — CUS.4.2 - Customer support process - Associated Work Products:

Input		Output	
31)	Review record	84)	Problem report record
41)	Field measure	89)	Training record
46)	Market analysis record	42)	Service level measure
51)	Contract	85)	Customer satisfaction survey
52)	Requirement specification (customer)	86)	Customer satisfaction data
82)	Customer support procedure	43)	Benchmarking data
83)	Customer request record	82)	Customer support procedure
84)	Problem report		
85)	Customer satisfaction survey		

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Input		Output
87)	Communication mechanism	
90)	Training material	
88)	Training strategy/plan	
98)	Tracking system	
105)	Customer documentation	

A.2.2 Engineering Process Category (ENG)

ENG.1 - Development process

Refer to the 'work products associated with the component processes.

Table A.9 — ENG.1.1 - System requirements analysis and design process - Associated Work Products

Input		Output	
44)	Product need assessment	8)	Interface
46)	Market analysis	30)	Review strategy / plan
52)	Requirement specification (customer)	52)	Requirement specification (system)
52)	Requirement specification (maintenance)	53)	System design / architecture
83)	Customer request	58)	Traceability record/mapping
94)	Change request	68)	Acceptance test strategy / Plan
98)	Tracking system	69)	Release strategy /plan
		87)	Communication mechanism

Table A.10 — ENG.1.2 - Software requirements analysis process - Associated Work Products

Input		Output	
44)	Product need assessment	8)	Interface
52)	Requirement specification (customer)	21)	Analysis result
52)	Requirement specification (maintenance)	31)	Review record
53)	System design / architecture	52)	Requirement specification (software)
58)	Traceability record / mapping	58)	Traceability record/mapping
83)	Customer request	69)	Release strategy /plan
87)	Communication mechanism	87)	Communication mechanism
84)	Problem report	93)	Configuration item
94)	Change request	100)	Product configuration
101)	Database design	105)	Customer documentation

Table A.11 — ENG.1.3 - Software design process - Associated Work Products

Input		Output	
2)	Life cycle model	54)	High level software design
33)	Reuse strategy / plan	55)	Low level software design
52)	Requirement specification (software)	58)	Traceability record/mapping
53)	System design / architecture	63)	Unit test strategy / plan
59)	Test strategy / plan	101)	Database design
		105)	Customer documentation

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Table A.12 — ENG.1.4 - Software construction process - Associated Work Products

Input		Output	
10)	Coding standard	56)	Software units (code)
35)	Reuse repository	59)	Test strategy / plan
52)	Requirement specification (software)	60)	Unit test script
52)	Requirement specification (system)	61)	Test case
53)	System design / architecture	62)	Test result
54)	High level software design	63)	Unite test strategy / plan
55)	Low level software design	92)	Configuration item
63)	Unit test strategy / plan		
91)	Configuration management strategy / plan		
101)	Database design		

Table A.13 — ENG.1.5 - Software integration process - Associated Work Products

Input		Output	
52)	Specification requirement (system)	65)	Integration test strategy / plan
52)	Specification requirement (software)	67)	Regression test strategy
52)	Specification requirement (maintenance)	58)	Traceability record/mapping
54)	High level software design	57)	Build list
55)	Low level software design	64)	Software item test plan
53)	System design / architecture	60)	Software item test script
56)	Software unit (code)	61)	Test case
57)	Build list	62)	Test result
60)	Test script	72)	Integrated software
61)	Test case		
69)	Release strategy /plan		
95)	Change control record		

Table A.14 — ENG.1.6 - Software testing process - Associated Work Products

Input		Output	
52)	Specification requirement (system)	58)	Traceability record / mapping
52)	Specification requirement (software)	60)	Integrated software test script
52)	Specification requirement (maintenance)	61)	Test case
53)	System design / architecture	62)	Test result
54)	High level software design	65)	Integration test strategy/plan
55)	Low level software design	67)	Regression test strategy
57)	Build list	72)	Integrated software
60)	Test script	100)	Product configuration
61)	Test case	105)	Customer documentation
64)	Software test strategy / plan		
67)	Regression test strategy / plan		
69)	Release strategy / plan		
72)	Integrated software		
92)	Configuration Management (file, library, system)		
95)	Change control record		
105)	Customer documentation		

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Table A.15 — ENG.1.7 - System integration and testing process - Associated Work Products

Input	Output
52) Specification requirement (system)	16) System integration strategy/plan
52) Specification requirement (software)	57) Build list
52) Specification requirement (maintenance)	58) Traceability record/mapping
53) System design / architecture	66) System integration test plan
54) High level software design	60) System integration test script
60) Test script	61) Test case
61) Test case	62) Test results
64) Software test strategy / plan	66) System test plan
66) System test strategy / plan	67) Regression test strategy
67) Regression test strategy / plan	60) System test script
69) Release strategy /plan	73) System
72) Integrated software	100) Product configuration
92) Configuration Management (file, library, system)	105) Customer documentation
95) Change control record	
105) Customer documentation	
107) System components	

Table A.16 — ENG.2 - System and software maintenance process - Associated Work Products

Input	Output
17) Project plan	16) Maintenance strategy/plan
21) Analysis result	52) Requirement specification (maintenance)
33) Reuse strategy / plan	21) Analysis result
34) Testing strategy	52) Requirement specification (system)
41) Field measure	52) Requirement specification (software)
44) Product need assessment	95) Change control record
51) Contract	69) Release strategy /plan
52) Requirement specification (customer)	70) Release package
53) System design / architecture	71) Release information
67) Regression test strategy	
69) Release strategy /plan	
80) Handling and storage guide	
83) Customer request	
84) Problem report	
92) Configuration Management (file, library, system)	
94) Change request	
95) Change control	
99) Work-around (temporary solutions)	
102) Back-up / Recovery record	
107) System component	

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A.3 Supporting Life Cycle Processes

A.3.1 Support process category

Table A.17 — SUP.1 - Documentation Process - Associated Work Products

Input		Output	
9)	Standard	7)	Work product
27)	Quality criteria	14)	Documentation policy
30)	Review plan	17)	Project plan (documentation)
44)	Product need assessment	31)	Review record
52)	Requirement specification (customer)	52)	Requirement specification (Documentation)
52)	Requirement specification (documentation)	79)	Delivery record
53)	System design / architecture	81)	Acceptance record
77)	Distribution list	93)	Configuration item
78)	Delivery instruction	95)	Change control
83)	Customer request	96)	Change history
84)	Problem report		
92)	Configuration management system		
94)	Change request		

Table A.18 — SUP.2 - Configuration Management Process - Associated Work Products

Input		Output	
69)	Release strategy /plan	20)	Progress status record / report
84)	Problem report	57)	Build list
91)	Configuration management plan	70)	Release package
92)	Configuration management (file, library, system)	72)	Integrated software
		80)	Handling and storage guide
93)	Configuration item	87)	Communication mechanism
94)	Change request	92)	Configuration management (file, library, system)
95)	Change control record	93)	Configuration item
96)	Change history	95)	Change control record
98)	Tracking system	96)	Change history
100)	Product configuration	91)	Configuration management plan

Table A.19 — SUP.3 - Quality Assurance Process - Associated Work Products

Input		Output	
1)	Software development methodology	3)	Process description
3)	Process description	4)	Job procedure, practice
4)	Job procedures, practice	9)	Standard
7)	Work product description	19)	Meeting minutes
9)	Standard	20)	Progress status record / report
17)	Project plan	21)	Analysis result
24)	Quality statement (policy)	25)	Quality plan/strategy
25)	Quality strategy/plan	27)	Quality criteria
28)	Quality record	28)	Quality record
27)	Quality criteria	29)	Assessment / audit record

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Input		Output	
30)	Review strategy/plan	31)	Review record
38)	Process measure	97)	Corrective action
39)	Quality measure		
37)	Project measure		
52)	Requirement specification		

Table A.20 — SUP.4 - Verification Process - Associated Work Products

Input		Output	
1)	Software development methodology	16)	Verification plan/strategy
3)	Process description	19)	Meeting minutes
6)	Work breakdown structure	21)	Analysis result
7)	Work product	28)	Quality record
9)	Standard	29)	Assessment / audit record
10)	Coding standard	31)	Review records
14)	Verification policy	39)	Quality measure
17)	Project plan	58)	Traceability record / mapping
20)	Progress status report	84)	Problem report record
27)	Quality criteria	97)	Corrective actions
25)	Quality strategy/plan	98)	Tracking system
30)	Review strategy/plan		
52)	Requirement specification		
59)	Test strategy/plan		
84)	Problem report record		
98)	Tracking system		

Table A.21 — SUP.5 - Validation Process - Associated Work Products

Input		Output	
1)	Software development methodology	16)	Validation plan/strategy
3)	Process description	19)	Meeting minutes
7)	Work product	21)	Analysis result
9)	Standard	28)	Quality record
14)	Validation policy	31)	Review record
17)	Project plan	39)	Quality measure
25)	Quality strategy/plan	58)	Traceability record / mapping
27)	Quality criteria	60)	Test script
30)	Review strategy/plan	61)	Test case
39)	Quality measures	62)	Test result
52)	Requirement specification (test)	84)	Problem report record
58)	Traceability Record / mapping	97)	Corrective action
59)	Test strategy/plan	98)	Tracking system
67)	Regression test strategy / plan		
65)	Integration test strategy / plan		
64)	Software test plan		
84)	Problem report record		

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Table A.22 — SUP.6 - Joint Review Process - Associated Work Products

Input		Output	
3)	Process description	19)	Meeting minute
17)	Project plan	21)	Analysis result
18)	Process performance data	26)	Improvement opportunity
19)	Meeting minutes	29)	Assessment / audit record
20)	Progress status report	31)	Review record
22)	Risk analysis	30)	Review strategy / plan
23)	Risk management plan	58)	Traceability record / mapping
25)	Quality strategy / plan	81)	Acceptance record
30)	Review strategy / plan	84)	Problem report record
31)	Review record	86)	Customer satisfaction data
37)	Project measure	97)	Corrective action
38)	Process measure	109)	Contract review record
39)	Quality measure		
42)	Service level measure		
51)	Contract		
52)	Requirement specification (customer)		
68)	Acceptance test plan		
83)	Customer request		
84)	Problem report		
87)	Communication mechanism		
98)	Tracking system		

Table A.23 — SUP.7 - Audit Process - Associated Work Products

Input		Output	
3)	Process description	5)	Schedule
4)	Job procedure, practice	16)	Plan (audit)
9)	Standard	21)	Analysis result
12)	Quality goal	29)	Assessment / audit record
14)	Audit policy	58)	Traceability record / mapping
16)	Plan (audit)	97)	Corrective action
20)	Progress status record / report		
25)	Quality strategy / plan		
27)	Quality criteria		
29)	Assessment/audit record		
38)	Process measure		
51)	Contract		
52)	Requirement specification (customer)		
59)	Test plan		
84)	Problem report		
86)	Customer satisfaction data		
62)	Test result		
97)	Corrective action		
98)	Tracking system		

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Table A.24 — SUP.8 - Problem Resolution Process - Associated Work Products

Input		Output	
20)	Progress status record / report	21)	Analysis result
21)	Problem analysis result	26)	Improvement opportunity
30)	Review strategy : plan	31)	Review record
31)	Review record	52)	Maintenance requirement
39)	Quality measure	58)	Traceability record / mapping
41)	Field measure	69)	Release strategy /plan
42)	Service level measure	84)	Problem report
62)	Test result	94)	Change request
83)	Customer request	95)	Change control
84)	Problem report	96)	Change history
96)	Change history	97)	Corrective action
97)	Corrective action	98)	Tracking system
98)	Tracking system		

A.4 Organizational Life Cycle Processes

A.4.1 Management process category

Table A.25 — MAN.1 - Management Process - Associated Work Products

Input		Output	
1)	Software development methodology	6)	Work breakdown structure
2)	Life cycle model	5)	Schedule
4)	Job procedure, practice	11)	Estimate
7)	Work product	17)	Project plan
9)	Standard	18)	Process performance data
12)	Business goal	20)	Progress status report
16)	Business plan	21)	Analysis result
18)	Process performance data	23)	Risk management plan
24)	Quality statement/policy	25)	Quality strategy/plan
38)	Process measure	30)	Review strategy/plan
51)	Contract	31)	Review record
52)	Requirements specification (customer, software, system)	33)	Project’s reuse strategy
		38)	Process measure
50)	Commitment /agreement	45)	Project’s acquisition strategy/plan
87)	Communication mechanism	58)	Traceability record / mapping
88)	Training strategy plan	84)	Problem report / record
98)	Tracking system	87)	Communication mechanism
		97)	Corrective action
		108)	Personnel record

Table A.26 — MAN.2 - Project management process - Associated Work Products

Input		Output	
1)	Software development methodology	2)	Life cycle model
2)	Life cycle model	5)	Schedule
4)	Job procedure, practice	6)	Work breakdown structure

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Input		Output	
5)	Schedule	8)	Interface
9)	Standard	11)	Estimate
18)	Process performance data	17)	Project plan
22)	Risk analysis	20)	Progress status report
23)	Risk management strategy / plan	21)	Analysis result
24)	Quality statement/policy	31)	Review record
37)	Project measure	30)	Review strategy/plan
38)	Process measure	33)	Project's reuse strategy
50)	Commitment /agreement	37)	Project measure
51)	Contract	45)	Project's acquisition strategy/plan
52)	Requirement specification (customer, software, system)	87)	Communication mechanism
91)	Configuration management strategy / plan	91)	Configuration management plan
98)	Tracking system	97)	Corrective action
104)	Development environment	108)	Personnel record

Table A.27 — MAN.3 - Manage quality - Associated Work Products

Input		Output	
6)	Work break down structure	4)	Job procedure / practice
17)	Project plan	5)	Schedule
16)	Business plan	6)	Work break down structure
20	Progress status report / record	12)	Quality goal
24)	Quality statement / policy	17)	Project plan
25)	Quality plan	18)	Process performance data
28)	Quality record	21)	Analysis result
29)	Assessment / audit record	25)	Quality strategy/plan
30)	Review strategy / plan	26)	Improvement opportunity
31)	Review record	29)	Assessment audit / record
41)	Field measure	31)	Review record
52)	Requirement specification (customer)	39)	Quality measure
84	Problem report record	97)	Corrective action

Table A.28 — MAN.4 - Manage risks - Associated Work Products

Input		Output	
1)	Software development methodology	18)	Process performance data
5)	Schedule	22)	Risk analysis
6)	Progress status report	23)	Risk management strategy / plan*
11)	Estimate	*Note: could be included as a part of any Plan = 16)	
12)	Business goal	29)	Assessment / audit record
17)	Project plan	31)	Review record
20	Progress status record / report	40)	Risk measure
23)	Risk management strategy / plan	97)	Corrective action
25)	Quality strategy / plan	98)	Tracking system
30)	Review strategy / plan		
37)	Project measure		
38)	Process measure		

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Input		Output
39)	Quality measure	
41)	Field measure	
42)	Service level measure	
52)	Customer requirement	
59)	Test plan	
74)	Installation plan	
86)	Customer satisfaction data	

A.4.2 Organization process category

Table A.29 — ORG.1 - Organizational alignment process - Associated Work Products

Input		Output	
2)	Life cycle model	3)	Process description
9)	Standard	5)	Schedule
12)	Business goal	6)	Work breakdown structure
13)	Vision	8)	Interface
14)	Policy	12)	Team goal
17)	Project plan	13)	Vision
24)	Quality statement / policy	14)	Policy
25)	Quality strategy plan	15)	Personnel policy
46)	Market analysis record / report	16)	Plan
86)	Customer satisfaction data	17)	Project plan
		24)	Quality statement / policy
		25)	Quality strategy / plan
		27)	Quality criteria
		50)	Commitment / agreement
		87)	Communication mechanism
		108)	Personnel record

ORG.2 - Improvement process

Refer to the work products associated with the component processes.

Table A.30 — ORG.2.1 - Process establishment process - Associated Work Products

Input		Output	
1)	Software development methodology	3)	Process description
2)	Life cycle model	4)	Job procedure
9)	Standard	5)	Schedule
12)	Business goal	6)	Work breakdown structure
13)	Vision	8)	Interface
14)	Policy	9)	Standard
24)	Quality statement / policy	12)	Process goal
25)	Quality strategy / plan	14)	Policy
29)	Assessment / audit record	16)	Plan
31)	Review record	21)	Analysis result
32)	Reuse plan	24)	Quality statement / policy
33)	Reuse strategy	27)	Quality criteria

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Input		Output	
39)	Quality measure	28)	Quality record
43)	Benchmarking data	30)	Review strategy/plan
47)	Request for proposal	31)	Review record
50)	Commitment / agreement	38)	Process measure
51)	Contract	77)	Distribution list
52)	Requirement specification (product / service)	87)	Communication mechanism
		89)	Training record
		44)	Product needs assessment

Table A.31 — ORG.2.2 - Process assessment process - Associated Work Products

Input		Output	
1)	Software development methodology	12)	Goal
2)	Life cycle model	16)	Plan
3)	Process description	18)	Process performance data
9)	Standard	21)	Analysis result
12)	Business goal	22)	Risk analysis record / report
13)	Vision	23)	Risk management strategy / plan
14)	Policy	26)	Improvement opportunity
16)	Plan	28)	Quality record
18)	Process performance data	29)	Assessment / audit record
20)	Progress status record / report	38)	Process measure
24)	Quality statement / policy	43)	Benchmarking data
25)	Quality strategy / plan	97)	Corrective action
27)	Quality criteria		
28)	Quality record		
29)	Assessment / audit record		
30)	Review strategy / plan		
31)	Review record		
36)	Measure		
37)	Project measure		
38)	Process measure		
39)	Quality measure		
40)	Risk measure		
41)	Field measures		
42)	Service level measure		
43)	Benchmarking data		
44)	Product needs assessment		
46)	Market analysis record / report		
84)	Problem report record		
86)	Customer satisfaction data		
104)	Development environment		
108)	Personnel record		
109)	Contract review record		

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Table A.32 — ORG.2.3 - Process improvement process - Associated Work Products

Input		Output	
1)	Software development methodology	3)	Process description
2)	Life cycle model	12)	Process goals
3)	Process description	17)	Project plan
9)	Standard	18)	Process performance data
12)	Process goal	21)	Analysis results
13)	Vision	22)	Risk analysis record/report
14)	Policy	23)	Risk management strategy/plan
18)	Process performance data	25)	Quality strategy/plan
21)	Analysis result	26)	Improvement opportunity
24)	Quality statement / policy	29)	Assessment/audit record
26)	Improvement opportunity	37)	Project measures
28)	Quality record	38)	Process measures
29)	Assessment / audit record	39)	Quality measures
31)	Review record	42	Service level measures
36)	Measure	43)	Benchmarking data
37)	Project measure	77)	Distribution list
38)	Process measure	84)	Problem report record
39)	Quality measure	87)	Communication mechanism
40)	Risk measure	94)	Change request
41)	Field measure	95)	Change control record
42)	Service level measure	96)	Change history
43)	Benchmarking data	97)	Corrective action
84)	Problem report	104)	Development environment
86)	Customer satisfaction data		
97)	Corrective action		
104)	Development environment		

Table A.33 — ORG.3 - Human resource management process - Associated Work Products

Input		Output	
3)	Process description	4)	Job procedure
4)	Job procedure, practice	5)	Schedule
6)	Work breakdown structure	12)	Goal
9)	Standard	14)	Policy
12)	Goal	15)	Personnel policy
13)	Vision	16)	Plan
15)	Personnel policy	19)	Meeting minutes
16)	Business plan	36)	Staff performance measure
17)	Project plan	50)	Commitment / agreement
23)	Risk management strategy / plan	87)	Communication mechanism
36)	Measure	88)	Training strategy / plan
44)	Product need assessment	89)	Training record
87)	Communication mechanism	90)	Training material
88)	Training strategy / plan	97)	Corrective action
89)	Training record	108)	Personnel record
90)	training material		
108)	Personnel record		

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Table A.34 — ORG.4 - Infrastructure process - Associated Work Products

Input		Output	
1)	Software development methodology	1)	Software development methodology
2)	Life cycle model	2)	Life cycle model
7)	Work product	3)	Process description
9)	Standard	9)	Standard
12)	Business goal	14)	Policy
13)	Vision	17)	Project plan
14)	Policy	27)	Quality criteria
17)	Project plan	32)	Reuse plan
16)	Business plan	33)	Reuse strategy
21)	Analysis result	35)	Reuse repository
23)	Risk management	31)	Review record
24)	Quality statement / policy	39)	Quality measure
25)	Quality strategy / plan	52)	Requirement specification (product/ service/ customer/ system/ software)
33)	Reuse strategy	87)	Communication mechanism
32)	Reuse plan	92)	Configuration management (file, library system)
44)	Product need assessment	95)	Change control record
84)	Problem report	103)	Recovery plan
95)	Change control	104)	Development environment
52)	Requirement specification (environment)	102)	Backup / recovery record
52)	Requirement specification (product/ service/ customer/ system/ software)	103)	Recovery strategy / plan
94)	Change request		

Table A.35 — ORG.5 - Measurement Process - Associated Work Products

Input		Output	
7)	Work product	18	Process performance data
9)	Standard	21)	Problem analysis result
27)	Quality Criteria	31)	Review record
37)	Project measure	37)	Project measure
38)	Process measure	38)	Process measure
39)	Quality measure	39)	Quality measure
40)	Risk measure	40)	Risk measure
41)	Field measure	41)	Field measure
42)	Service level measure	42)	Service level measure
43)	Benchmarking data	43)	Benchmarking data
44)	Product needs assessment	95)	Change control
52)	Requirement specification (measurement)	96)	Change history
53)	Process description	84)	Problem report
77)	Distribution list	97)	Corrective action
83)	Customer request		

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Table A.36 — ORG.6 - Reuse Process - Associated Work Products

Input		Output	
1)	Software development methodology	7)	Work Product
9)	Standard	32)	Reuse plan
14)	Reuse policy	33)	Reuse strategy / specification
32)	Reuse plan	34)	Reusable object
33)	Reuse strategy	35)	Reuse Repository
44)	Product need assessment	92)	Configuration management library
52)	Requirement specification (reuse)	95)	Change control record
53)	System design / architecture		
54)	High level software design		
55)	Low level software design		
56)	Software unit		
83)	Customer request		
92)	Configuration management library		

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Annex B
(informative)

Indicators of process capability

B.1 Introduction

Practice performance characteristics, resources and infrastructure characteristics and associated processes, listed in this annex, may be used when assessing management practices for a particular process implementation. These characteristics and associated processes provide guidance to find objective evidence supporting the effective implementation of the management practice. A methodology and assessor judgement is needed to ensure that the process context (application domain, business purpose, development methodology, size of the organization, etc.) is considered when using this information. The tables should not be considered as check-lists of what every organization must do or have, but rather as a starting point for considering whether, given the context, management practices are effectively performed, thus contributing to the achievement of the related process attribute.

B.2 Capability level 1 : Performed process

The base practices that are associated with the performance of the process have to be considered, unless they are not relevant in the context of the process instance. Any other practices that are essential to the achievement of the process purpose in the context of the process instance may also be considered.

NOTE To evaluate the Level 1 management practices, use the indicators of process performance defined in clause 5 (Base practices), Annex A (Work products associated to processes) and Annex C (Work product characteristics).

B.2.1 Process attribute 1.1 – Process performance attribute

The extent to which the process achieves the process outcomes by transforming identifiable input work products to produce identifiable output work products.

Table B.1 — Management practice 1.1.1

Indicator Class	Indicators
MP 1.1.1	Identify input and output work products.
Practice performance characteristics	For each process assessed, the input work products are identified. For each process assessed, the output work products are identified. For each process assessed: — Associated work products exist, among those defined in annexe A that are applicable according to the process context; — input and output work products have characteristics to indicate an adequate implementation (see the applicable characteristics among those included in the annex C). The existing work products satisfy the purpose of the process. A mechanism exists to distribute the work products. Work products are delivered to users on a need to know basis.
Resource and infrastructure characteristics	Resources for process performance are available. *8 See Process dimension*

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Indicator Class	Indicators
MP 1.1.1	Identify input and output work products.
Associated Processes	Not applicable

Table B.2 — Management Practice 1.1.2

Indicator Class	Indicators
MP 1.1.2	Ensure that the scope of work is identified for process execution and for the work products to be used and produced by the process.
Practice performance characteristics	For each process, the scope of work in performing the process is identified
Resource and infrastructure characteristics	*See Process dimension.*
Associated Processes	Not applicable

Table B.3 — Management Practice 1.1.3

Indicator Class	Indicators
MP 1.1.3	Ensure that base practices are implemented, producing work products which support achievement of the defined process outcomes.
Practice performance characteristics	For each process, there is evidence that base practices are actually performed. The base practices of a process achieve the defined purpose and process outcome. The base practices of a process produce the output work products. Work products produced satisfy the purpose of the process.
Resource and infrastructure characteristics	*See Process dimension.*
Associated Processes	Not applicable

B.3 Capability level 2 – Managed process

B.3.1 Process attribute 2.1 – Performance management attribute

The extent to which the performance of the process is managed to produce work products that meet the defined objectives.

Table B.4 — Management practice 2.1.1

Indicator Class	Indicators
MP 2.1.1	Identify the objectives for the performance of the process (for example, time-scale, cycle time and resource usage)
Practice performance	Performance objectives are: — based on historical information when available

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Indicator Class	Indicators
MP 2.1.1	Identify the objectives for the performance of the process (for example, time-scale, cycle time and resource usage)
characteristics	— consistent with resources available — based on process requirements Process measures used in estimation are identified and used Estimates include accuracy and confidence limits
Resource and infrastructure characteristics	Sizing methods and tools Productivity and effort estimation methods and tools Historical data of the process performance Customer's software and/or system requirements
Associated Processes	MAN.1 Management process MAN.2 Project management process CUS.3 Requirements elicitation process MAN.4 Risk management process SUP.6 Joint review process

Table B.5 — Management practice 2.1.2

Indicator Class	Indicators
MP 2.1.2	Plan the performance of the process according to the identified objectives by identifying the activities of the process, the expected time schedule and allocation of resources for each activity
Practice performance characteristics	Work breakdown structure. Standards to be used are identified and available. Special needs and infrastructure (facilities, tools, personnel) are identified, along with resources to obtain the special need Reuse strategy is defined and identifies the — key elements to be reused — the objectives for reuse — the mechanism used to implement reuse Risks are identified and reflect the — resources utilization — availability of resources — schedule constraints — cost constraints — technical risks Schedule is defined which — reflects the constraints considered (resources, time, personnel skills) — contains appropriate contingency time — meets customers needs and objectives The plan defined is — complete — accurate — easy to understand — available to those performing the task — consistent with schedule needs and project objectives — contains project commitments The plan covers the strategy (approach / methodology / life cycle) to perform the process.

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Indicator Class	Indicators
MP 2.1.2	Plan the performance of the process according to the identified objectives by identifying the activities of the process, the expected time schedule and allocation of resources for each activity
Resource and infrastructure characteristics	PERT/CPM techniques Project planning tools (which support selected techniques) Project management/control tools Communication means, procedures and tools Risk models, identification means and prevention knowledge
Associated Processes	MAN.1 Management process MAN.2 Project management process MAN.3 Quality management ORG.3 Human resource management ORG.4 Infrastructure

Table B.6 — Management practice 2.1.3

Indicator Class	Indicators
MP 2.1.3	Plan and assign the responsibility and authority for developing the work products of the process
Practice performance characteristics	Tasks and work products are allocated to resources Responsibility and authority are agreed and documented Work products availability milestones are defined Verification responsibility is defined and allocated
Resource and infrastructure characteristics	Project planning tools (which support selected techniques) — Project management/control tools — Communication means, procedures and tools — Workflow management tools — Communication mechanisms
Associated Processes	MAN.1 Management process MAN.2 Project management process SUP.3 Quality assurance ORG.3 Human resource management

Table B.7 — Management practice 2.1.4

Indicator Class	Indicators
MP 2.1.4	Manage the execution of the activities by continued tracking and re-planning to produce work products that meet the defined objectives
Practice performance characteristics	Process performance is tracked using measurement. Strategy to implement corrective actions is settled and is known by all who need it. Evidence exists that the plans defined are used by the organization: — Planned milestones are achieved or re-planning is performed — Schedule is consistent with the plan defined or re-planning performed — Resources used are in line with those specified in the plan or re-planning performed — task completion verification mechanisms exists

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Indicator Class	Indicators
MP 2.1.4	Manage the execution of the activities by continued tracking and re-planning to produce work products that meet the defined objectives
	— quality criteria are evaluated at key milestones in the defined process. Estimates are maintained regularly and used for process performance tracking. Potential risks identified in the plan are tracked. Input/output Work products are monitored for — demonstrating the full achievement of the current task — sufficiency to perform the next task — completeness at the start of the next task — availability to those who need them in a time frame to support activities of the next task. Reviews, self-assessments and / or audits of the process and plan are performed on a regular scheduled basis. Review, self-assessment and audit results are documented and used. Corrective actions are identified and accepted. Corrective actions are taken as planned. Corrective actions are tracked.
Resource and infrastructure characteristics	Periodic review of project plans. Process/Plan monitoring tools Communication tools. Problem report and corrective actions database. Meeting mechanisms. Audit team/resources
Associated Processes	MAN.1 Management process MAN.2 Project management process MAN.4 Risk Management SUP.3 Quality Assurance SUP. 7 Audit SUP.8 Problem resolution

B.3.2 Process attribute 2.2 – Work product management attribute

The extent to which the performance of the process is managed to produce work products that are appropriately documented, controlled, and verified.

Table B.8 — Management Practice 2.2.1

Indicator Class	Indicators
MP 2.2.1	Identify the requirements for the work products, including both functional and non-functional aspects
Practice performance characteristics	List of work products to be reviewed are identified and documented The criteria for work products integrity is available and documented The criteria for work products quality is available and documented Acceptance criteria for work products are defined Policy for configuration management and change control is established. Requirement traceability is defined for the work products: — when CASE tools are used to store work product outputs, their requirements traceability capabilities are defined — list of work products to be reviewed for the process are identified and documented in plan

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Indicator Class	Indicators
MP 2.2.1	Identify the requirements for the work products, including both functional and non-functional aspects
	Functional, non-functional and quality requirements, where they exist, for work products are defined The strategy for integrity and quality assurance activities is available and documented, in order to give confidence in meeting the above requirements for the work products
Resource and infrastructure characteristics	Quality policy Quality system elements Configuration management system
Associated Processes	CUS.3 Requirements elicitation SUP.2 Configuration management SUP.3 Quality assurance

Table B.9 — Management practice 2.2.2

Indicator Class	Indicators
MP 2.2.2	Manage the documentation, configuration management and change control of the work products
Practice performance characteristics	Maintain the traceability of functional, non-functional and quality requirements, where they exist, for work products. All appropriate work product are maintained under configuration management. Work Products identified for the process have version indicators identified, for example — on-line documents have ability to generate version information — printed documents have version identifiers on them Baselined copies of the work product for the process correspond to the project's current development status Current status of the work product can be readily ascertained Work products are accessible to organizational unit personnel with a "need to know" Change control is established for items baselined under Configuration Management — change control procedure requires approval for change to baselined products — a mechanism to track changes made is established — process revisions are proactively made available to those who need them — a mechanism to inform project personnel of changes made to baselined documents exist Version numbers with traceability to dates corresponding change requests; defined ownership; central repository
Resource and infrastructure characteristics	Inspections check lists A storage mechanism for configured items exists, such as — paper document library — project files or binders — on-line configuration management system library Traceability of customer requirements

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Indicator Class	Indicators
MP 2.2.2	Manage the documentation, configuration management and change control of the work products
	Problem reporting database Configuration management tools, including version control and change control tools The configuration management (CM) mechanism — has archival / retrieval capabilities — has an index of items under CM — has controlled access procedures — indicates the status of items under CM — has a version indicator scheme Work products repository
Associated Processes	SUP.1 Documentation SUP.2 Configuration management SUP.3 Quality assurance

Table B.10 — Management practice 2.2.3

Indicator Class	Indicators
MP 2.2.3	Identify and define any work product dependencies
Practice performance characteristics	Activities to manage and control changes are identified Time, content and resource dependencies are identified and documented Traceability of functional, non-functional and quality requirements, where they exist, for work products is maintained All appropriate work product are maintained under configuration management
Resource and infrastructure characteristics	Traceability of customer requirements Configuration management tools, including version control and change control tools:
Associated Processes	CUS.3 Requirements elicitation SUP.1 Documentation SUP.2 Configuration management SUP.3 Quality assurance

Table B.11 — Management practice 2.2.4

Indicator Class	Indicators
MP 2.2.4	Manage the quality of work products to ensure that they meet their functional and non-functional requirements.
Practice performance characteristics	Impacts of changes to other work products are documented and analyzed. Quality criteria for work product completion verifies usage of the standards and/or procedures. Work products are reviewed according to integrity and quality assurance activities such as: — verification of standards and/or requirements — records review indicating usage of project standards and requirements Evidence exist that demonstrates the implementation of integrity and quality assurance activities. For example, records of reviews exist which show : — that appropriate expertise participated in the review

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Indicator Class	Indicators
MP 2.2.4	Manage the quality of work products to ensure that they meet their functional and non-functional requirements.
	— the time spent for the review — problems that were identified have — corrective actions plans with target closure dates — status indicators — person responsible for closure — the status of the work product after the review Quality and coverage criteria is available for the work product reviewed which assess: — the completeness of the work product — the adherence to standards — the coverage of requirements — if the information is understandable — usability for the subsequent task — accuracy and validity Evidence of closure exists for any corrective action
Resource and infrastructure characteristics	Traceability of requirements Check-list Tools, forms Quality assurance group Problem reporting database.
Associated Processes	MAN.3 Quality management SUP.3 Quality assurance SUP.4 Verification SUP.5 Validation SUP.7 Audit SUP.8 Problem resolution process

B.4 Capability Level 3 : Established process

B.4.1 Process attribute 3.1 – Process definition attribute

The extent to which the performance of the process uses a process definition based upon a standard process to achieve the process outcomes.

Table B.12 — Management practice 3.1.1

Indicator Class	Indicators
MP 3.1.1	Identify the standard process that supports the execution of the managed process and provides documented guidance on tailoring
Practice performance characteristics	The organization's standard process documentation exists and includes: — Expected input and output work products — Work break down structure : — Tasks to be performed in line with the associated base practices — task ownership — Objective criteria for demonstrating the task completeness — Definition of internal and external interfaces, and dependencies

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Indicator Class	Indicators
MP 3.1.1	Identify the standard process that supports the execution of the managed process and provides documented guidance on tailoring
	— Quality controls: — Process entry and exit criteria — Process decision control points (possible milestones) — Expected process performance data when performing the standard process. Process performance data may address: — Resources (person, skills), — Infrastructure, duration for a task, — Cost, number of loops in a part of the process, etc. — Written organization policy for performing the process Documentation of the standard process definition originated from the current practices performed throughout the organization exists and is validated and approved; Standard process definition is available to all with a need-to-know in the organization: — paper documentation distributed to key process users — on-line documentation is accessible to key process users
Resource and infrastructure characteristics	Software process library Documentation tools Process modelling tools Software databases Standards Configuration management tools.
Associated processes	ORG.2.1 Process establishment SUP.1 Documentation Process

Table B.13 — Management practice 3.1.2

Indicator Class	Indicators
MP 3.1.2	Implement and/or tailor the standard process to obtain a defined process appropriate to the process context
Practice performance characteristics	The standard Process documentation, and the guidance on tailoring to obtain a defined process, is available to those who need it Organizational representatives have been educated to the defined processes they are used Training for the standard process is adapted for the defined standard process and available to those who need it. Evidence, records as identified in the documentation of the defined process exist to demonstrate its implementation defined Management is regularly reviewing the appropriateness of the defined process with respect to the process purpose Support for the defined process is available to the users Guidance on how to tailor the standard process exist when appropriate Tailoring guide-lines contain criteria on what may be tailored and to which extent, which are based upon the process context: — The tailored process is a complete and fully-defined subset of the standard process definition

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Indicator Class	Indicators
MP 3.1.2	Implement and/or tailor the standard process to obtain a defined process appropriate to the process context
	— Explicit and documented rationale for process tailoring is available (see ISO/IEC 12207)
Resource and infrastructure characteristics	Appropriate process tools, depending on the specific purpose of the process
Associated Processes	ORG.2.1 Process establishment

Table B.14 — Management practice 3.1.3

Indicator Class	Indicators
MP 3.1.3	Gather process performance data so that the behaviour of the defined process can be understood
Practice performance characteristics	The process performance data is collected as required by the standard process Reporting channel is existing in order to enable every body to address any issue (question / answer) about the implementation of the defined process Standard process documentation is adapted to include best practice feedback from the tailored process
Resource and infrastructure characteristics	Library of information and data related to the use of the standard process Data collection mechanisms
Associated Processes	MAN.2 Project Management ORG.2.1 Process establishment ORG.2.2 Process assessment

Table B.15 — Management practice 3.1.4

Indicator Class	Indicators
MP 3.1.4	Establish and refine the understanding of the process behaviour by using process performance data
Practice performance characteristics	Reports are collected and circulated to relevant personnel in the organization Historical process performance data is established Trends are elaborated based on the analysis of historical process performance data
Resource and infrastructure characteristics	Library of information and data related to the use of the standard process Tools to manage experience data
Associated Processes	MAN.2 Project Management ORG.2.1 Process establishment ORG.2.2 Process assessment

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Table B.16 — Management practice 3.1.5

Indicator Class	Indicators
MP 3.1.5	Refine the standard process
Practice performance characteristics	Management is regularly reviewing Reporting from representatives who are using standard process and trends of process performance results; Experiences based on trends and reporting are analyzed and generalized to be usable to improve the standard process definition and documentation; Standard process documentation evolves: — to be in line with current practice — to include expected process performance data which are realistic
Resource and infrastructure characteristics	Library of information and data related to the use of the standard process Tools to manage experience data Analysis methods and tools
Associated Processes	ORG.2.3 Process improvement SUP.8 Problem resolution

B.4.2 Process attribute 3.2 – Process resource attribute

The extent to which the process draws upon suitable resources (for example, human resources and process infrastructure) that is appropriately allocated to deploy the defined process.

Table B.17 — Management practice 3.2.1

Indicator Class	Indicators
MP 3.2.1	Identify and document the roles, responsibilities and competencies required to support the implementation of the defined process
Practice performance characteristics	Required human resource needs in terms of numbers, duration and skills are identified. In identifying the needs: — the full range of skills to cover the scope of the process purpose is addressed — the use of multi-skilled teams is considered — performance standards are defined
Resource and infrastructure characteristics	Classification scheme of typical competencies related to the standard process. Labour force skills databases.
Associated Processes	ORG.3 Human resources management ORG.2.1 Process establishment

Table B.18 — Management practice 3.2.2

Indicator Class	Indicators
MP 3.2.2	Provide, allocate and use the resources to support the performance of the defined process.
Practice performance characteristics	Human resources needed for performance of the process are formally acquired across the organization as identified in MP 3.2.1 : — skills profiles of available staff are determined — appropriate staff are recruited where necessary — training is provided to staff as needed to meet the requirements of the process;

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Indicator Class	Indicators
MP 3.2.2	Provide, allocate and use the resources to support the performance of the defined process.
	Evidence of required staff allocation exists: — Process representative(s) indicate that resources are sufficient to perform tasks assigned — Tracking of the defined process execution shows resource utilization consistent with current project plans
Resource and infrastructure characteristics	Human resource selection procedures Mentoring plan Formal course materials Written project materials On-line job aids Video library Skills database Training curricula Overtime records Tracking system tool
Associated Processes	MAN.1 Process management ORG.4 Human resources management process

Table B.19 — Management practice 3.2.3

Indicator Class	Indicators
MP 3.2.3	Identify and document the process infrastructure requirements to support the implementation of the defined process
Practice performance characteristics	Required infrastructure needs in terms of facilities, software tools, hardware, software, equipment, methods, tools, techniques, standards are identified: — Description of the infrastructure — characteristics (delay to obtain it, cost, maintenance, etc.) Appropriate information exists to obtain and install the infrastructure (booking, ordering, workspace, etc.) Sufficient support and documentation is available in order to use the infrastructure
Resource and infrastructure characteristics	Organizational software engineering environment Workspace Training equipment Funding
Associated Processes	ORG.4 Infrastructure process ORG.2.1 Process establishment process

Table B.20 — Management practice 3.2.4

Indicator Class	Indicators
MP 3.2.4	Provide, allocate and use an adequate process infrastructure to support the performance of the defined process
Practice performance characteristics	Appropriate infrastructure is acquired Evidence (Records, plan, etc.) of required infrastructure exists : — Process representative(s) indicate that infrastructure is sufficient to perform tasks assigned

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Indicator Class	Indicators
MP 3.2.4	Provide, allocate and use an adequate process infrastructure to support the performance of the defined process
	— Tracking of the defined process execution shows resource utilization consistent with current project plans — Sufficient support and documentation for the process infrastructure is available
Resource and infrastructure characteristics	Tracking system tool
Associated Processes	ORG.4 Infrastructure process

B.5 Capability Level 4 : Predictable process

B.5.1 Process attribute 4.1 – Measurement attribute

The extent to which product and process goals and measures are used to ensure that performance of the process supports the achievement of the defined goals in support of the relevant business goals.

Table B.21 — Management practice 4.1.1

Indicator Class	Indicators
MP 4.1.1	Identify product and process goals and measures which support the achievement of the relevant business goals.
Practice performance characteristics	Top management available for review of both business and process goals Process goals are identified in accordance and explicit relation to business goals Data needed to monitor achievement of the defined goals is identified and the relationship to goals established When defining measures consideration is given to ensure — usability of measures — applicability of measures to the project — availability of measures to those with a "need to know" — completeness of source data used to generate the results — validation of the accuracy of the source data The measures identified are: — usable — understood by those expected to utilize them — provide value to users in the organization — non-disruptive to the work flow Measurements to track status of the process identify — key process attributes to be tracked — status of deliverables — quality of deliverables Project measures cover key elements of the project plan — process / critical task status — project performance against plan

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Indicator Class	Indicators
MP 4.1.1	Identify product and process goals and measures which support the achievement of the relevant business goals.
	— resource utilization against plan — time schedule against plan — process quality measures — product quality measures Identified product metrics to enable productivity estimation and quality metrics
Resource and infrastructure characteristics	Top Management Indicators (cost, time, reliability, profitability, risk) Library or other sources of measurement techniques Statistical Process Control techniques to determine Process Capability
Associated Processes	MAN.2 Project management MAN.3 Quality Management MAN.4 Risk management ORG.1 Organizational alignment

Table B.22 — Management practice 4.1.2

Indicator Class	Indicators
MP 4.1.2	Collect the specified product and process measures through performing the defined process.
Practice performance characteristics	Required data is collected in an effective and reliable manner and made available to management and staff. Measures are reported with the frequency and timeliness defined. Measurements are validated to insure they are a good reflection of the actual status The reporting interval is appropriate for the life cycle model used. Process measures are collected which monitor — timeliness planned tasks — completeness of planned tasks — sufficiency of the deliverable for the next task — the quality of the end customer deliverable The measures used are indicative of the process' performance — progress deviations are identified — measures show planned vs. Actual — process defects are identified — process quality vs. Objectives/criteria Tools are available for collecting, storage and handling of data Provisions for data integrity are established Measurements are available.
Resource and infrastructure characteristics	Status reports Quality record Tools for data collection and handling Workflow management tools Defect recording/tracking system Process performers are trained in statistical process control
Associated Processes	MAN.2 Project management ORG.4 Infrastructure

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Table B.23 — Management practice 4.1.3

Indicator Class	**Indicators**
MP 4.1.3	Analyze trends in the performance of the process across the organization.
Practice performance characteristics	Milestones / quality objectives for each process are established. Measurement reports are available to those with a need to know — managers — process owners — interface groups — quality representatives — customers Organizational unit representatives understand the documented metrics for process and product Quality assurance activities or techniques are performed to ensure data quality
Resource and infrastructure characteristics	Quality records Tools for data collection and handling Status reports Workflow management tools Defect recording/tracking system
Associated Processes	MAN.2 Project management MAN.3 Quality management

Table B.24 — Management practice 4.1.4

Indicator Class	**Indicators**
MP 4.1.4	Measure the process capability and maintain it within the defined limits across the organization.
Practice performance characteristics	Measurements from the process are compared to process goals The measures used are indicative of the process' performance — progress deviations are identified — measures show planned vs. Actual — process defects are identified — process quality vs. Objectives/criteria When projects performance is deviating from planned activities or performance goals — problems area are identified which have associated corrective actions — established plans and schedules are adjusted — notification is given to dependent task owners and customers Feedback (reports) is provided to those with a need to know — managers — process owners — interface groups — quality representatives — customers Measurement results are used in managing the process — project management plans reflect the use of the defined process measures Corrective action results are monitored through the use of process measurement trend data Periodical review of resource allocations Control charts are used to track the process.

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Indicator Class	Indicators
MP 4.1.4	Measure the process capability and maintain it within the defined limits across the organization.
Resource and infrastructure characteristics	Process Management Tools/Applications Product Measurement Tools/Applications Statistical analysis tools/applications Status reports, deviation reports Top Management Indicators (cost, time, reliability, profitability, risk) Tracking systems with embedded statistical process control facilities Corrective action reports
Associated Processes	MAN.2 Project management MAN.3 Quality management MAN.4 Risk management SUP.3 Quality assurance SUP.8 Problem resolution ORG.2.3 Process improvement

B.5.2 Process attribute 4.2 – Process control attribute

The extent to which the process is controlled through the collection, analysis, and use of product and process measures to correct, where necessary, the performance of the process to achieve the defined product and process goals.

Table B.25 — Management practice 4.2.1

Indicator Class	Indicators
MP 4.2.1	Identify suitable measurement techniques, appropriate to the process context, to support process and product improvement.
Practice performance characteristics	Process control techniques establish — adequate sampling — how to define process control parameters — how to detect deviations from parameters — how to detect trends and other out of control patterns — how to establish the statistical validity of results When identifying which analysis and control techniques to be used, consideration is given to ensure — usability of the analysis results — applicability of the analysis results — completeness of source data used to generate the results — validation of the accuracy of the results Analysis techniques may include some or all of: — histograms — Pareto analysis — statistical control charts — non-parametric analysis — process capability profiles Process control and analysis techniques have proved to be suitable and effective given the instance context Tool and other infrastructure requirements are identified

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Indicator Class	Indicators
MP 4.2.1	Identify suitable measurement techniques, appropriate to the process context, to support process and product improvement.
Resource and infrastructure characteristics	Process control techniques library or other source of Process control tools Process assessment tools Statistical analysis tools/applications
Associated Processes	MAN.3 Quality management ORG.2.3 Process improvement

Table B.26 — Management practice 4.2.2

Indicator Class	Indicators
MP 4.2. 2	Collect measures and identify process control parameters in order to perform analysis
Practice performance characteristics	A mechanism is defined to facilitate monitoring of the process, project, and product to identify when corrective actions are required evidence exists that process and product metrics are used — process and product metrics are a good reflection of the actual status (with meaningful interpretation) Process assessment results are available: — results identify capabilities of the defined process — results are stored for future use — results are measured against available benchmarks, target profiles Process measures are used to monitor the process performance at key points in the defined process — quality thresholds established are evaluated against actual performance — measurement trend analysis data is used to determine the process capability results Analysis reports are available to those with a need to know — managers — process owners — interface groups — quality representatives — customers
Resource and infrastructure characteristics	Statistical analysis techniques Software process assessment framework Process Control Tools/Applications Process Capability Assessment Tools/Applications
Associated Processes	MAN.2 Project management MAN.3 Quality management

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Table B.27 — Management practice 4.2.3

Indicator Class	Indicators
MP 4.2.3	Control the process performance using the analysis measures to identify actions to maintain control and/or implement improvement
Practice performance characteristics	When projects performance is deviating from planned control parameters — problem areas are identified which have associated corrective action — established plans and schedules are adjusted — notification is given to dependent task owners and customers Analysis results are used in managing the process — change management criteria reflect the use of process trends — corrective actions are defined when data indicates deviations from established parameters Corrective action results are monitored through the use of process measurement trend data — results are measured against available benchmarks, target profiles Process measures are used to monitor the process performance at key points in the defined process Quality thresholds established are evaluated against actual performance
Resource and infrastructure characteristics	Process performance /capability results repository/history Software process assessment framework Process management tools/applications Status reports, deviation reports Tracking systems Corrective action reports
Associated Processes	ORG.1 Organizational alignment ORG.2.3 Process improvement

B.6 Capability Level 5 : Optimizing process

B.6.1 Process attribute 5.1 – Process change attribute

The extent to which changes to the definition, management and performance of the process are controlled to achieve the relevant business goals of the organization.

Table B.28 — Management Practice 5.1.1

Indicator Class	Indicators
MP 5.1.1.	Identify changes to the standard process definition on the basis of a quantitative understanding of the process.
Practice performance characteristics	Affected tailored processes are identified and their change history is known and analyzed Responsibility is assigned for co-ordinating the quantitative analysis of potential changes to the organization's standard process definition Causal analysis is used to identify earliest points to eliminate process defect A strategy for data collection and quantitative analysis for process change purpose is defined and documented Measures that validate the results of process changes are defined and documented, to determine expected effectiveness of the process change

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Indicator Class	Indicators
MP 5.1.1.	Identify changes to the standard process definition on the basis of a quantitative understanding of the process.
Resource and infrastructure characteristics	Change management mechanisms Process definition and modelling tools Process metrics database Analysis tools (statistics, root causes) Scheduled periodic reviews Communication mechanisms to inform and review changes
Associated Processes	MAN.3 Quality management ORG.2.1 Process establishment ORG.2.3 Process improvement ORG.4 Human resource management

Table B.29 — Management practice 5.1.2

Indicator Class	Indicators
MP 5.1.2.	Assess the impact of all proposed changes against the defined product and process goals of the defined and standard processes.
Practice performance characteristics	Causal analysis is used to identify earliest points to eliminate process defect Proposed process changes are planned, documented and piloted to determine their benefits and expected effectiveness A strategy for data collection and quantitative analysis for process change purpose is defined and documented Measures that validate the results of proposed process changes are defined and documented, to determine expected effectiveness of the process change Metrics are reviewed with organizational management prior to incorporating changes into the affected processes
Resource and infrastructure characteristics	Management commitment Change management mechanisms Process definition and modelling tools Process metrics database Analysis tools (statistics, root causes) Scheduled periodic reviews Communication mechanisms to inform and review changes
Associated Processes	MAN.3 Quality management ORG.2.1 Process establishment ORG.2.3 Process improvement ORG.4 Human resource management

Table B.30 — Management practice 5.1.3

Indicator Class	Indicators
MP 5.1.3	Define an implementation strategy for the approved change, ensuring that any disruption to the process performance is understood and acted upon
Practice performance characteristics	Documented, detailed process implementation strategy exists A mechanism exists that predicts process improvement based on process performance and includes trend analysis of process performance and analysis of proposed improvements

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Indicator Class	Indicators
MP 5.1.3	Define an implementation strategy for the approved change, ensuring that any disruption to the process performance is understood and acted upon
	An optimization mechanism exists which sets objective priorities for process improvement actions taking into account context specific requirements, benefit/cost analyses, risk assessment, the constrains for improvement and resources available The goals established for the process reflect: — the known process capability and target capability — a target date for when the desired capability will be achieved — the expected and potential cost/benefits of planned improvement activities The factors that impact effectiveness are known, such as: — economic factors (productivity, profit, growth, efficiency, quality, competition, resources, and capacity) — human factors (job satisfaction, motivation, morale, conflict/cohesion, goal consensus, participation, training, span of control) — management factors (skills, commitment, leadership, knowledge, ability) — technology factors (sophistication of system, technical expertise, development methodology, need of new technologies) Impact of changes to other portions of the tailored process are considered and those who are impacted by the changes are involved in determining the impact and in developing the implementation strategy and plan Implementation plan and impacts on business needs and goals are discussed and reviewed by senior management Implementation strategy includes training of personnel implementing change and using the new features of the process.
Resource and infrastructure characteristics	Management commitment and involvement Skilled and knowledgeable personnel Organized training
Associated Processes	ORG.1 Organizational alignment ORG.2.3 Process improvement

Table B.31 — Management practice 5.1.4

Indicator Class	Indicators
MP 5.1.4.	Implement the approved changes to the affected processes according to the implementation strategy
Practice performance characteristics	Mechanism exists for trialing changes for early feedback and for pilot testing Mechanism exists for incorporating accepted changes into the tailored process(es) effectively and completely Documented implementation plan for process change is done Quality assurance reviews/audits implementation activities and the corresponding reports are delivered to management Training to users of the process is provided once change has been implemented Measures of the changed process(es) are collected for validation purpose Results of change actions are monitored against established process measures and quality goals to determine if they were effective Historical record of the change are maintained

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Indicator Class	Indicators
MP 5.1.4.	Implement the approved changes to the affected processes according to the implementation strategy
Resource and infrastructure characteristics	Management commitment Change management and control mechanisms Process definition and modelling tools Communication tools Process metrics database Scheduled periodic reviews
Associated Processes	ORG.2.1 Process establishment ORG.2.3 Process improvement ORG.3 Human resource management ORG.4 Infrastructure

Table B.32 — Management practice 5.1.5

Indicator Class	Indicators
MP 5.1.5.	Evaluate the effectiveness of process change on the basis of actual performance against the defined product, process and business goals, making adjustments as needed
Practice performance characteristics	Process change is validated according to a validation plan. Those responsible for performing analysis are trained to do analysis and receive orientation in the organization's processes when appropriate (i.e., when they are not the process owners or maintainers). Data and the corresponding measures are gathered/derived according to pre-defined criteria: — the definition of the data to be collected exists, — measures to be derived, — source of data, — frequency of collection, — computation for deriving measures, — definition of computational parameters. Measures are analyzed using a pre-defined analysis process which specifies: — the purpose of the analysis, — the process(es) involved, — relates the analysis to the business goals of the organization Reviews of the change activities, defined metrics and the historical results of process changes are performed. A mechanism for documenting and reporting analysis results to management and owners of standard process definitions is available and documented.
Resource and infrastructure characteristics	Analysis tools Process metrics database Business goals at detailed level to allow analysis and validation activities Feedback mechanisms to all who need to know validation results Communication mechanism to ensure input to standard process definition (ORG.2) Records including lessons learned of change activities
Associated Processes	ORG.2.1 Process establishment ORG.2.3 Process improvement

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B.6.2 Process attribute 5.2 – Continuous improvement attribute

The extent to which changes to the process are identified and implemented to ensure continuous improvement in the fulfilment of the relevant business goals of the organization.

Table B.33 — Management practice 5.2.1

Indicator Class	**Indicators**
MP 5.2.1	Define the process improvement goals for the process that support the relevant business goals of the organization
Practice performance characteristics	New business visions and goals are analyzed to get guidance for new process goals and potential areas of process change Current capability assessment results and target profiles are available and analyzed for the process being assessed Feedback on opportunities for improvement is actively provided by the users/customers of the work products Corrective actions are analyzed and associated with process improvement needs A mechanism for analyzing and using measures from work product evaluation and joint reviews is available A mechanism exists which identifies the activities and corresponding responsibilities, that process improvement teams are to perform in order to identify and communicate process improvement opportunities
Resource and infrastructure characteristics	Senior management involvement Customer satisfaction studies Use of benchmarks and industrial databases Innovation mechanisms Early identification of new technologies R&D activities in related areas
Associated Processes	CUS.4.2 Customer support ORG.1 Organizational alignment ORG.2.3 Process improvement SUP.8 Problem resolution

Table B.34 — Management practice 5.2.2

Indicator Class	**Indicators**
MP 5.2.2	Analyse the source of real and potential problems in the current process, identifying improvement opportunities in a systematic and proactive manner to continuously improve the process
Practice performance characteristics	Causal analysis is used to identify earliest points to eliminate process defect. A documented, systematic mechanism exists for identifying, recording and analyzing improvement opportunities, for example: — customer satisfaction studies/surveys — brainstorming sessions — employee surveys — competitive and market studies — active use of information sources and databases — benchmarks and comparisons with other businesses and best practices — awards for new innovative ideas

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Indicator Class	Indicators
MP 5.2.2	Analyse the source of real and potential problems in the current process, identifying improvement opportunities in a systematic and proactive manner to continuously improve the process
	— piloting of emerging new technologies — research and development in related areas Current capability assessment results and target profiles are available and analyzed for the process being assessed. All parties are stimulated and encouraged to contribute to process improvement. Feedback on opportunities for improvement is actively provided by the users/customers of the work products. Corrective actions are analyzed and associated with process improvement needs. A mechanism for analyzing and using measures from work product evaluation and joint reviews is available. A mechanism exists which identifies the activities and corresponding responsibilities, that process improvement teams are to perform in order to identify and communicate process improvement opportunities.
Resource and infrastructure characteristics	Senior management involvement Customer satisfaction studies Use of benchmarks and industrial databases Analysis tools (statistics, root causes) Innovation mechanisms Early identification of new technologies R&D activities in related areas
Associated Processes	CUS 4.2 Customer support ORG.1 Organizational alignment ORG.2.3 Process improvement SUP.8 Problem resolution

Table B.35 — Management practice 5.2.3

Indicator Class	Indicators
MP 5.2.3	Implement changes to selected areas of the tailored process according to the implementation strategy.
Practice performance characteristics	Changes initiated are orderly and controlled: — impacts to organization are assessed before changes are implemented — potential changes are evaluated against the defined process effectiveness criteria — pilot testing of change(s) is performed — potential changes are benchmarked against existing process performance and improvement goals desired — effect of potential process change on current development is considered — goals/objectives to be achieved by process change defined — process change results are monitored for effectiveness — establishes target dates for completion of improvements Measures of the changed process(es) are collected for validation purpose. Results of change actions are monitored against established process measures

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Indicator Class	Indicators
MP 5.2.3	Implement changes to selected areas of the tailored process according to the implementation strategy.
	and quality goals to determine if they were effective Implementation includes training those using the new aspects of the process. Historical records of the process changes are maintained and extended
Resource and infrastructure characteristics	Skilled and knowledgeable personnel Organized training Management involvement in implementation of process improvement activities
Associated Processes	ORG.1 Organizational alignment ORG.2.3 Process improvement

Table B.36 — Management practice 5.2.4

Indicator Class	Indicators
MP 5.2.4	Validate the effectiveness of process change on the basis of actual performance against process and business goals and feedback to the standard process definition.
Practice performance characteristics	Validation of process change is done according to a detailed validation plan. Those responsible for performing analysis are trained to do analysis and receive orientation in the organization's processes when appropriate (i.e., when they are not the process owners or maintainers) Data and the corresponding measures are gathered/derived according to pre-defined criteria: — the definition of the data to be collected exists — measures to be derived — source of data — frequency of collection — computation for deriving measures — definition of computational parameters Measures are analyzed using a pre-defined analysis process which: — specifies the purpose of the analysis, — identifies the process(es) involved, — relates the analysis to the business goals of the organization A mechanism for documenting and reporting analysis results to senior management is available and documented Validation results are fed into the organization's standard process definition library and the corresponding process owners as feedback to further process improvement
Resource and infrastructure characteristics	Management commitment Skilled and knowledgeable personnel Scheduled periodic reviews Organized training
Associated Processes	ORG.1 Organizational alignment ORG.2.1 Process establishment ORG.2.3 Process improvement

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Annex C
(informative)

Work products and their characteristics

Work product characteristics listed in Table C.2 in this annex can be used when reviewing potential inputs and outputs of an organization's process implementation. The characteristics are provided as guidance for the attributes to look for, in a particular sample work product, to provide objective evidence supporting the assessment of a particular process. A methodology and assessor judgement is needed to ensure that the process context (application domain, business purpose, development methodology, size of the organization, etc.) is considered when using this information. This table C.2 should be considered as a starting point for considering whether, given the context, work products are contributing to the intended purpose of the process, not as a check-list of what every organization must have. The fields in the work product characteristics in table C.2 contain the following information.

Work product identifier #	An identifier number for the work product which is used to reference the work product.
Work product classification	Provides a classification of the work products into 3 categories : Organisation, Project and Records as shown in table C.1
Work product type	Provides an example of a typical name associated with the work product characteristics. This name is provided as an identifier of the type of work product the practice or process might produce. Organizations may call these work products by different names. The name of the work product in the organization is not significant. Similarly, organizations may have several equivalent work products which contain the characteristics defined in one work product type. The formats for the work products can vary. It is up to the assessor and the organizational unit co-ordinator to map the actual work products produced in their organization to the examples given here.
Work product characteristics	Provides examples of the potential characteristics associated with the work product types. The assessor may look for these in the samples provided by the organizational unit. It is likely that higher levels of process capability would imply a fuller instantiation of the work product characteristics.

Table C.1 — Work Product Classification

WP Category number	WP Category	WP Classification number	WP Classification
1	ORGANISATION :	*1.1*	Policy
		1.2	Procedure
		1.3	Standard
		1.4	Strategy
2	PROJECT :	*2.1*	Plan
		2.2	Requirement
		2.3	Design
		2.4	Implementation
		2.5	Product
		2.6	Interim deliverable
3	RECORDS :	*3.1*	Report
		3.2	Record
		3.3	Measure
		3.4	Data

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NOTE In Table C.2, Some work products are followed by the symbol + (n). This means that the work product is a specific example of a generic work product. The corresponding generic work product description contains the characteristics common to all work products of this type. Hence, the common characteristics should be considered in addition to the specific characteristics included for the work product in question.

Table C.2 — Key work product characteristics

ID	*WP class*	WP Type	WP Characteristics
1	*1.2*	Software development methodology	— Identification of the approach / method used to develop software — Identification of the life cycle model (waterfall, spiral, serial build, etc.) used to develop software — Provides a high level description of the process, activities, and controls
2	*1.3*	Life cycle model	— High level description of activities performed at each life cycle phase — Sequencing of the life cycle phases — Identification of critical life cycle phase dependencies — Identification of required inputs, outputs to each life cycle phase — Identification of the key decision points (milestones) model — Identification of the quality control points in the model

3	*1.2*	Process description	— A detailed description of the process which includes:
			  — tailoring of the standard process (if applicable)
			  — purpose of the process
			  — task and activities to be performed and ordering of tasks
			  — critical dependencies between task activities
			  — expected time required to execute task
			  — input/ outputs work products
			  — links between input and outputs work products
			— Identifies process entry and exit criteria
			— Identifies internal and external interfaces to the process
			— Identifies process measures
			— Identifies quality expectations
			— Identifies functional roles and responsibilities

4	*1.2*	Job procedure, practice	— Each task to be performed uniquely identified — Each task sequenced by execution order — Coverage of support information (i.e., commands and parameter settings, etc.) when required for operations — Establishes rules by which staff is expected to operate — Approved by authorised personnel
5	*2.1*	Schedule	— Identifies the tasks to be performed — Identifies the start and completion date for required tasks — Allows for the identification of critical tasks and task dependencies — Identifies task completion status, vs. planned date — Has a mapping to scheduled resource data
6	*2.1*	Work breakdown structure	— Defines tasks to be performed — Documents ownership for tasks — Documents critical dependencies between tasks — Documents inputs and output work products — Documents the critical dependencies between defined work products

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Table C.2 — Key work product characteristics (cont.)

ID	*WP class*	WP Type	WP Characteristics
7	*2.5*	Work product	— Defines the attributes associated with an artefact from a process execution: — key elements to be represented in the work product — expected form, style — expected media (paper, electronic) and storage attributes defined
8	*1.3*	Interface	— Defines relationships between two products, process or process tasks — Defines criteria and format for what is common to both — Defines criteria critical timing dependencies or sequence ordering
9	*1.3*	Standard	— Identification of who/what they apply to — Each requirement unique — Each requirement tagged with an identifier — Expectations for conformance are identified — Conformance to requirements can be demonstrated — Provisions for tailoring or exception to the requirements are included
10	*1.3*	Coding standard	— Coverage for software includes, but is not limited to (as appropriate to the application): — data naming conventions — defines required languages, compilers, data base management systems, etc. — format of code, structure, comments required — standard data structures, types, classes — best practices — required usage of tools: data dictionaries, associated CASE tools — compatibility requirement for existing software and / or hardware — security considerations — performance considerations — standard error messages, codes — Interface standards: — human - machine interfaces — external system interfaces — peripheral equipment, hardware — Storage and retrieval of source code and object modules — Quality and reliability standards
11	*3.3*	Estimate	— Coverage (as appropriate to the application) for elements such as: — size — effort — cost — schedule — resources — Estimates are realistic and achievable: — In line with resources allocated — in line with historical records (where they exist) — Source data needed to make estimates was available and complete — Source data was validated

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Table C.2 — Key work product characteristics (cont.)

ID	*WP class*	WP Type	WP Characteristics
12	*1.1*	Goal (business, quality, organizational, team, training, performance, process)	— Identifies the objective to be achieved — Identifies who is expected to achieve the goal — Identifies any incremental supporting goals — Identifies any conditions/ constraints — Identifies the timeframe for achievement — Are reasonable and achievable within the resources allocated — Are current, established for current project, organization — Used to monitor progress — Are optimized to support known performance criteria, plans
13	*1.1*	Vision	— Provides information on the overall strategy for the organizational unit, organization, or business — Is authorized at the highest level — Defines the main objectives to be achieved
14	*1.1*	Policy	— Authorized — Available to all personnel impacted by the policy — Establishes practices / rules to be adhered to
15	*1.1*	Personnel policy + (14)	— Defines career opportunities for individuals in the organization — Defines team building strategy — Defines reward and recognition — Covers performance appraisal

16	*2.1*	Plan
		(General attributes applies to all plans)
		(i.e., Business, Organization, Project, Quality, Review, Test)
			— (as appropriate to the application and purpose):
			— Identification of the plan owner
			— Includes:
			  — The objective of what is to be accomplished
			  — assumptions made
			  — constraints
			  — risks
			  — tasks to be accomplished
			  — schedules, milestones and target dates
			  — critical dependencies
			  — maintenance disposition for the plan
			— Method/approach to accomplish plan
			— Identifies:
			  — Task ownership
			  — quality criteria
			  — audit to be performed
			  — required work products
			— Includes resources to accomplish plan objectives
			  — Time
			  — staff
			  — materials/equipment
			  — budget
			— Includes contingency plan for non-completed tasks
			— Plan is approved

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Table C.2 — Key work product characteristics (cont.)

ID	*WP class*	WP Type	WP Characteristics
17	*2.1*	Project plan + (16)	— Defines: — Work products to be developed — life cycle model and methodology to be used — customer requirements — tasks to be accomplished — task ownership — project resources — schedules, milestones and target dates — quality criteria — Identifies: — Critical dependencies — required work products — project risks and risk mitigation plan — contingency actions for non-completed tasks
18	*3.4*	Process performance data	— Data comparing process performance against expected levels: — Defined input and output work products available — meeting minutes — change records — task completion criteria met — quality criteria met — resource allocation and tracking
19	*3.2*	Meeting minutes	— Documents meetings held — Defines: — Purpose of meeting — attendees — date, place held — what was accomplished — any open issues — next action
20	*3.2*	Progress Status record / report	— Record of the status of a plan(s) (actual against planned) such as: — Status of actual tasks against planned tasks — status of actual results against established objectives/goals — status of actual resource allocation against planned resources — status actual cost against budget estimates — status of actual time against planned schedule — status of actual quality against planned quality — Record of any deviations from planned activities and reason why
21	*3.4*	Analysis result	— What was analyzed — Who did the analysis — The analysis criteria used: — Selection criteria or prioritization scheme used — decision criteria — quality criteria — Records the results : — What was decided / selected — reason for the selection

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Table C.2 — Key work product characteristics (cont.)

ID	*WP class*	WP Type	WP Characteristics
			— assumptions made — potential risks — Aspects of correctness to analyze include: — Completeness — understandability — testability — verifiability — feasibility — validity — consistency — adequacy of content.
22	*3.2*	Risk analysis record / report	— Identifies the risks analyzed — Records the results of the analysis — potential ways to mitigate the risk — assumptions made — constraints
23	*1.4 / 2.1*	Risk management strategy / plan + (59)	— Project risks identified and prioritized — Mechanism to track the risk — Threshold criteria to identify when corrective action required — Proposed ways to mitigate risks: — work around — corrective actions activities / tasks — monitoring criteria — mechanisms to measure risk
24	*1.1*	Quality statement / policy + (14)	— Statement is official, approved — States commitment to quality principles — Identifies who is expected to follow policy
25	*1.4 / 2.1*	Quality strategy / plan + (16)	— Objectives / goal for quality — Defines the activities tasks required to ensure quality — References related work products — Method of assessment / assuring quality — References any regulatory requirements, standards, customer requirements — Identifies the expected quality criteria — Specifies the monitoring timeframe and quality checkpoints for the defined life cycle and associated activities planned — Target timeframe to achieve desired quality — Method to achieved goals — tasks to be performed — ownership for tasks — audit to be performed — resource commitments — Identifies the quality criteria for work products and process tasks — Specifies the threshold/tolerance level allowed prior to requiring corrective actions — Defines quality measurements and benchmark data

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Table C.2 — Key work product characteristics (cont.)

ID	*WP class*	WP Type	WP Characteristics
			— Defines the quality record collection mechanism and timing of the collection — Specifies mechanism to feed collected quality record back into process impacted by poor quality — Approved by the quality responsible organization/function
26	*1.4*	Improvement opportunity	— Identifies what the problem is — Identifies what the cause of a problem is — Suggest what could be done to fix the problem — Identifies the value (expected benefit) in performing the improvement — Identifies the penalty for not making the improvement
27	*3.3*	Quality criteria	— *Defines expectations for quality:* — Establishes what is an adequate work product (required elements, completeness expected, accuracy, etc.) — Identifies what constitutes the completeness of the defined tasks — Establishes life cycle transition criteria and the entry and exit requirements for each process and / or activity defined — Establishes expected performance attributes — Establishes product reliability attributes
28	*3.2*	Quality record	— Defines what information to keep — Defines what tasks/activities/process produce the information — Defines when the data was collected — Defines source of any associated data — Identifies the associated quality criteria — Identifies any associated measurements using the information — Identifies any requirements adherence to create the record, or satisfied by the record

29	*3.2*	Assessment / audit record	— States the purpose of assessment
			— Method used for assessment
			— Requirements used for the assessment
			— Assumptions and limitations
			— Identifies the context and scope information required:
			  — date of assessment
			  — organizational unit assessed
			  — sponsor information
			  — assessment team
			  — attendees
			  — scope / coverage
			  — assessees' information
			  — assessment Instrument (check-list, tool) used
			— Records the result
			  — identifies the required corrective actions
			  — improvement opportunities

30	*1.4 / 2.1*	Review strategy / plan + (16)	— Defines:
			  — what to be reviewed
			  — roles and responsibilities of reviewers
			  — criteria for review (check-lists, requirements, standards)

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Table C.2 — Key work product characteristics (cont.)

ID	*WP class*	WP Type	WP Characteristics
			— expected preparation time — schedule for reviews — Identification of: — procedures for conducting review — review inputs and outputs — expertise expected at each review — review records to keep — review measurements to keep — resources, tools allocated to the review
31	*3.2*	Review record	— Provides the context information about the review — what was reviewed — lists reviewers who attended — status of the review — Provides information about the coverage of the review — check-lists — review criteria — requirements — compliance to standards — Records information about the readiness for the review — preparation time spent for the review — time spent in the review — reviewers , roles and expertise — Identifies the required corrective actions — risk identification — prioritized list of deviations and problems discovered — the actions, tasks to be performed to fix the problem — ownership for corrective action — status and target closure dates for identified problems
32	*2.1*	Reuse plan + (16)	— Defines the policy about what items to be reused — Defines standards for construction of reusable objects — defines the attributes of reusable components — quality/reliability expectations — standard naming conventions — Defines the reuse repository (library, CASE tool, file, data base, etc.) — Identifies reusable components — directory of component — description of components — applicability of their use — method to retrieve and use them — restrictions for modifications and usage — Method for using reusable components — Establishes goal for reusable components
33	*1.4 / 2.2*	Reuse strategy / specification	— Identify the goals for reuse are stated — Identify the commitment for creating reusable components — Determine which product lines and type of artefacts should be supported with reuse

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Table C.2 — Key work product characteristics (cont.)

ID	*WP class*	WP Type	WP Characteristics
			— Identify system and software components which can be reused within the organization — Identify the reuse repository and tools
34	*2.5*	Reusable object	— Developed to be: — highly reliable — generically defined (generic names, structures, etc.) — interfaces (inputs and outputs) clear — data encapsulated — Modification controlled — Modifications are downward compatible — Specification for usage defined — Specification for tailoring defined
35	*2.5*	Reuse repository	— Repository for reusable components (library, file, data base, tool) — Storage and retrieval capabilities — Ability to browse content — Listing of contents with description of reusable attributes — Ability to identify associated system information — type of object maintained — supported software / applications — associated hardware configuration information — required parameter information
36	*3.3*	Measure (general applies to all specific measures)	— Available to those with a need to know — Understood by those expected to use them — Provides value to the organization/project — Non-disruptive to the work flow — Appropriate to the process, life cycle model, organization — is accurate — source data is validated — results are validated to ensure accuracy — Has appropriate analysis and commentary to allow meaningful interpretation by users
37	*3.3*	Project measure + (36)	— *Coverage for key elements in the project plan such as:* — Monitors key processes and critical tasks provides status information to the project on: — project performance against established plan — resource utilization against established plan — time schedule against established plan — process quality against quality expectations and / or criteria — product quality against quality expectations and / or criteria — highlight software performance problems, trends — References any goals established
38	*3.3*	Process measure + (36)	— Measures about the process' performance: — ability to produce sufficient work products — adherence to the process — time it takes to perform process — defects related to the process

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Table C.2 — Key work product characteristics (cont.)

ID	*WP class*	WP Type	WP Characteristics
			— Measures the impact of process change — Measures the efficiency of the process
39	*3.3*	Quality measure + (36)	— Measures quality attributes of the work products defined — product is adequate to do the job intended — product is defect free — product is usable — product is complete — product is accurate — product is reliable — Measures the results of project activities — tasks are performed on schedule — product's development is within the resource commitments allocated — Measures quality attributes of the "end customer" product quality and reliability
40	*3.3*	Risk measure + (36)	— Identifies the probability of risk occurring — Establishes measures for each risk defined — Measures the change in the risk state
41	*3.3*	Field measure + (36)	— Measures attributes of the performance of system's operation at field locations, such as: — field defects — performance against defined service level measures — system ability to meet defined customer requirements — support time required — user complaints (may be third party users) — customers requests for help — performance trends — problem reports — enhancements requested
42	*3.3*	Service level measure + (36)	— Real time measures taking while a system is operational, it measures the system's performance or expected service level — Identifies things like: — capacity — throughput — operational performance — operational service — service outage time — up time — job run time
43	*3.4*	Benchmarking data + (36)	— Identifies key process / product / market need information to be benchmarked — Measurement reflects comparison of the current performance against some well defined criteria or historical information (or benchmark)
44	*2.2*	Product need assessment	— Coverage for key elements (as appropriate to the application): — Definition of the need: — reason product is needed

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Table C.2 — Key work product characteristics (cont.)

ID	*WP class*	WP Type	WP Characteristics
			— features and functions desired — requirements to be satisfied — Constraints: — cost limitations — date / schedule requirements — specific support software required — interfaces requirements — associated equipment or hardware required — regulatory standards and/or requirements — operational impacts — patent, copyright and licensing issues — Business case: — expected benefit — expected cost (including projected installation, conversion and/or maintenance) vs. profit expectations — market window, target delivery dates
45	*1.4 / 2.1*	Acquisition strategy / plan +(16)	— Identifies what needs to be acquired — Establishes the approach for acquiring the product or service; options might include: — off-the-shelf — develop internally — develop through contract — enhance existing software product — or combination of these — Establishes the evaluation criteria — acceptance strategy. — Identifies any constraints / risks
46	*3.1 / 3.2*	Market analysis record / report	— Contains information about: — what was analyzed — the selection criteria & prioritization scheme used — the analysis criteria used — Records the results which identify the: — market opportunities and market window — business drivers — cost / benefit — potential customers and their profiles information — any assumptions made — alternate solutions considered and / or rejected — risks and/or constraints (regulatory issues) — Defines the product offering and target release
47	*2.2*	Request for proposal (RFP) (Requester)	— Reference to the requirements specifications — Identifies desired characteristics, such as: — system architecture, configuration requirements or the requirements for service (consultants, maintenance, etc.) — quality criteria or requirements — project schedule requirements

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Table C.2 — Key work product characteristics (cont.)

ID	*WP class*	WP Type	WP Characteristics
			— expected delivery / service dates — cost / price expectations — regulatory standards / requirements — Identifies submission constraints: — date for resubmitted of the response — requirements with regard to the format of response
48	*2.1*	Supplier proposal response (Response to RFPs)	— Defines the suppliers proposed solution — Defines the suppliers proposed delivery schedule — Identifies the coverage identification of initial proposal — identifies the requirements that would be satisfied — identifies the requirements that could not be satisfied, and provides a justification of variants — Defines the estimated price of proposed development, product, or service
49	*3.2*	*Subcontractor* or *supplier* history record	— List of potential subcontractor/suppliers — Qualification information — Identification of their qualifications — Past history information when it exists
50	*3.2*	Commitment / agreement	— Signed off by all parties involved in the commitment / agreement — Establishes what the commitment is for — Establishes the resources required to full fill the commitment, such as: — time — people — budget — equipment — facilities
51	*3.2*	Contract (product or service)	— Signed — Defines what is to be purchased/delivered — Identifies time frame for delivery or contracted service dates — Identifies monetary considerations — Identifies any warranty information — Identifies any copyright and licensing information — Identifies any customer service requirements — References to any performance and quality expectations/ constraints/ monitoring — Standards and procedures to be used — As appropriate to the contract the following are considered: — references to any acceptance criteria — references to any special customer needs (i.e., confidentiality requirements, security, hardware, etc.) — references to any change management and problem resolution procedures — identifies any interfaces to independent agents and subcontractors — identifies customer's role in the development and maintenance process — identifies resources to be provided by the customer

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Table C.2 — Key work product characteristics (cont.)

ID	*WP class*	WP Type	WP Characteristics

52	*2.2*	Requirement specification (*internal or external*)
		
		(Product, Service, Customer, System, Software, Documentation, Environment)
			— Each requirement is identified
			— Each requirement is unique
			— Each requirement is verifiable or can be assessed
			— Includes statutory and regulatory requirements
			— Includes issues/requirements from (contract) review
			— Consideration is given to the following (as appropriate to the product or service and type of requirement)
			— *Products / Application requirements :*
			  — identify any required feature and functional characteristics
			  — identify any necessary performance considerations/constraints
			  — identify any necessary internal/ external interface considerations/ constraints
			  — identify any required system characteristics / constraints
			  — identify any human engineering considerations/ constraints
			  — identify any security considerations/constraints
			  — identify any environmental considerations/constraints
			  — identify any operational considerations/constraints
			  — identify any maintenance considerations/constraints
			  — identify any associated documentation considerations/constraints
			  — identify any installation considerations/constraints
			  — identify any support considerations/constraints
			  — identify any design constraints
			  — identify any safety/reliability considerations/constraints
			  — identify any quality requirements/expectations
			  — includes storage requirements (products)
			— *Service requirements :*
			  — identify any performance expectations
			  — identify any time schedule / constraints
			  — identify any tasks to be performed
			  — identify any responsibilities
			  — identify the method of communication, project reporting expected
			  — identify any quality expectations / controls
			— *Document requirements :*
			  — purpose / objectives defined
			  — proposed contents (coverage) defined
			  — intended Audience defined
			  — identification of supported software release, system information
			  — identification of associated software requirements and designs satisfied by document
			  — identification of style, format, media standards expected
			  — definition of the intended distribution requirement
			  — includes storage requirements

53	*2.3*	System design / architecture	— Provides an overview of all system design — Describes the interrelationship between system components — Describes the relationship between the system components and the software

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Table C.2 — Key work product characteristics (cont.)

ID	*WP class*	WP Type	WP Characteristics
			— Specifies the design for each required system component consideration is given to things like: — memory/capacity requirements — hardware interfaces requirements — user interfaces requirements — external system interface requirements — performance requirements — commands structures — security / data protection characteristics — system parameter settings — manual operations — reusable components — Mapping of requirements to system components
54	*2.3*	High level software design	— Describes the overall software structure — Identifies the required software components — Identifies the relationship between software components — Consideration is given to: — any required software performance characteristics — any required software interfaces — any required security characteristics required — any database design requirements — any required error handling & recovery attributes
55	*2.3*	Low level software design	— Provides detailed design (could be represented as a prototype, flow chart, entity relationship diagram, pseudo code, etc.) — Provides format of input/output data — Provides specification of data storage needs — Establishes required data naming conventions — Defines the format of required data structures — Defines the data fields and purpose of each required data element — Provides the specifications of the program structure
56	*2.5*	Software unit (code)	— Follows established coding standards (as appropriate to the language and application): — commented — structured or optimized — meaningful naming conventions — parameter information identified — error codes defined — error messages descriptive and meaningful — formatting - indented, levels — Follows data definition standards (as appropriate to the language and application): — variables defined — data types defined — classes and inheritance structures defined — objects defined — Entity relationships defined

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Table C.2 — Key work product characteristics (cont.)

ID	*WP class*	WP Type	WP Characteristics
			— Data base layouts are defined — File structures and blocking are defined — Data structures are efficient — Algorithms defined are efficient — Functional interfaces defined
57	*2.4*	Build list	— Identification of aggregates of the software application system — Identification of required system components (parameter settings, macro libraries, data bases, job control languages, etc.) — Necessary sequence ordering identified for compiling the software release — Input and output source libraries identified
58	*3.2*	Traceability record / mapping	— Identifies requirements to be traced — Identifies a mapping of requirement to life cycle work products — Provides the linkage of requirements to work product decomposition (i.e., requirement →design →code →test →deliverables, etc.) — Provides forward and backwards mapping of requirements to associated work products throughout all phases of the life cycle — Note: this may be included as a function of another defined work product (example: A CASE tool for design decomposition may have a mapping ability as part of it's features)
59	*1.4 / 2.1*	Test strategy / plan (all test plans) + 16	— Identification of test purpose — Identification of the responsible test plan owner — Identifies the approach to performing the test — Identification of components to be tested — Identify aggregates and sequence for testing — Identify urgent release — Identification of required system configuration — (software, hardware, interface components) — Identification of the associated development owner for components to be tested — Identification of associated test scripts/test cases — Sequence ordering of how testing will be executed — Identification of *requirements* which will be validated by tests (i.e., customer requirement, regulatory requirements and system requirements — Identification of the problem reporting mechanism — Identification of the test tools and resources required (test channels, analyzers, test emulators, etc.) — Identification of the test schedule — Identification of the test completion criteria — Identification of audits to be performed — Official source libraries and versions of software defined
60	*2.3*	Test script	— Defines what is being tested — Defines the required system configuration for the test — Identifies all required software components — Identifies special initializations, parameter setting, etc.

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Table C.2 — Key work product characteristics (cont.)

ID	*WP class*	WP Type	WP Characteristics
			— Identifies the input date required — Sequences the ordering of the test cases — Defines the expected test results — Identifies what requirements were met by performing the test
61	*2.3*	Test case	— Provides executable set of test instructions — Purpose defined — Defines the expected test result — Mapped to test scripts, requirements
62	*3.2*	Test result	— Records results of testing — Identifies what components were tested — Identifies date test was executed — Status at completion of test (actual test results compared to predicted results in test plan(s)) — Record of test configuration at time of test — Record of trouble reports generated from testing
63	*1.4 / 2.1*	Unit test strategy / plan + (59)	— Identifies strategy for verifying unit functionality — (i.e., a program, a block, a module, a routine) against the requirements and design — Specifies how basic program requirements will be verified
64	*1.4 / 2.1*	Software test strategy / plan + (59)	— Identifies strategy for verifying software features and/or functions operate as defined in the requirements
65	*1.4 / 2.1*	Integration test strategy / plan + (59)	— Purpose of integration defined: — validation of a subset of the system (all programs required to make a sub-system work, a feature work, etc.) — validation of the integration of software to other system components (hardware, support equipment, interfaced system)
66	*1.4 / 2.1*	System test strategy / plan + (59)	— Identifies strategy for verifying the integration of system components as defined in the system architecture specification — Provides test coverage for all components of the system: — software — hardware — external interfaces — customer documentation — installation activities — initialization — conversion programs
67	*1.4 / 2.1*	Regression test strategy / plan + (59)	— Plan for validating that existing systems / features-functions have not been impacted by a change — Plan for validating that change has not impacted working components of the system (interfaces, operations, etc.) — Plan for validating that change is compatible with existing system requirements (downward compatible) — Identification of the requirements for system component *not* changed — Identification of what system components are to be regression tested (i.e., features, functions, interfaces, fixes)

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Table C.2 — Key work product characteristics (cont.)

ID	*WP class*	WP Type	WP Characteristics
			— Identification of the changes made — Identification of the regression test cases to be executed — Conditions for execution of regression testing
68	*1.4 / 2.1*	Acceptance test strategy / plan + (59)	— Identified activities to be performed to test "deliverable" end customer product — Identifies who has responsibility for performance of acceptance test activities (supplier or customer) — Identifies the system configuration requirements for site — Identifies the installation requirements for site — Provides a plan for validating the "delivered" software — Identifies how to validate installation activities at customers site were performed correctly — Identifies how to validate the deliverables satisfied the customer requirements — Identifies associated test scripts/test cases — Identifies actions to be take upon acceptance of product — Refers to Quality plan
69	*1.4 / 2.1*	Release strategy / plan + (16)	— Identifies the functionality to be included in each release — Identifies the associated components required — (i.e., hardware, software, documentation etc.) — Mapping of the customer requests, requirements satisfied to particular releases of the product

70	*2.5*	Release package	— Includes the software
			— Includes and associated release elements such as:
			  — system software components
			  — required hardware
			  — associated customer documentation
			  — parameter definitions defined
			  — command language defined
			  — installation instructions
			  — release letter

71	*2.5*	Release (notes) information	— Coverage for key elements (as appropriate to the application):
			— Description of what is new or changed (including features removed)
			— System information and requirements
			— Identification of conversion programs and instructions
			— Identification of the component list (version identification included)
			  — software modules, libraries, etc.
			  — associated documentation list
			  — associated hardware requirements
			— New / changed parameter information and/or commands
			— Backup and recovery information
			— List of open known problems, faults, warning information, etc.
			— Identification of verification and diagnostic procedures
			— Technical support information
			— Copyright and license information

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Table C.2 — Key work product characteristics (cont.)

ID	*WP class*	WP Type	WP Characteristics
72	*2.6*	Integrated software	— All components specified on a software build list for the aggregate is included — Fully configured aggregate of the software components: — parameters defined — commands defined — data loaded or converted
73	*2.5*	System	— All components of the product release are included — Any required hardware — Integrated software — Customer documentation — Fully configured set of the "system components": — parameters defined — commands defined — data loaded or converted
74	*1.4 / 2.1*	Installation strategy plan + (16)	— Identifies product deployment objectives — Identifies schedules for deployment activities — Identifies schedule constraints — Identifies impacted site locations — Identifies site environment configuration — Identification of the required components for the installation with appropriate version information (consideration given to at least the following): — released software — type of media — required maintenance fixes — support software required (conversion programs, validation routines, associated system interfaces, data base management system) — required customer documentation — installation instructions — identification of required hardware and peripheral equipment — Identification of supporting information or materials required: — parameter information — operation and maintenance information — pre-conversion information, materials or installed equipment — Type of installation (new vs. conversion of existing system, maintenance) — Identification of backup and recovery procedures — Identification of customer contacts and technical support personnel — Custody of master and backup copies — Identification of *go / no-go* decision criteria — Identification of verification process: — of required tasks to prepare deliverables required — of components required at site — of installation procedures — of pre- installation construction or conversion activities — of system integration, release builds, etc.

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Table C.2 — Key work product characteristics (cont.)

ID	*WP class*	WP Type	WP Characteristics
			— Identification of customer acceptance requirements — Identification of any copyright and licensing requirements — Identification of any safety and security requirements
75	*2.5*	Installation guide	— *Coverage for key elements (as appropriate to the application):* — Tasks for loading/installing product sequentially order by execution requirements — downloading of software from delivery files — up-loading to appropriate software to files, folders, libraries, etc. — partial or upgrade installation instructions, where applicable — initialization procedures — conversion procedures — customization / configuration procedures — verification procedures — bring-up procedures — operations instructions — Installation requirements identified: — associated hardware, software, customer documentation — conversion programs and instructions — initialization programs, system generation information — components and descriptions — minimum configuration of hardware/software required — backup / recovery instructions — validation programs — configuration parameters (e.g. size requirements, memory, etc.) — Customer / technical support contacts
76	*3.2*	Packaging record	— Content information of what is shipped or delivered electronically — Special handling instructions
77	*3.2*	Distribution list	— List of current list of receivers and their delivery address — Identification of media expected for delivery (manual, CD-ROM, email, etc.)
78	*2.5*	Delivery instructions	— Coverage for key elements (as appropriate to the application): — Sequential ordering of tasks to be performed — Applicable releases identified — Identification of all delivered components with version information — Identification of any necessary backup and recovery procedures
79	*3.2*	Delivery record	— Record of items shipped/delivered electronically to customer — Identification of: — who it was sent to — address where delivered — the date delivered — Record receipt of delivered product
80	*2.5*	Handling and storage guide	— Defines the tasks to perform in handling and storing products including: — providing for master copies of code and documentation; — disaster recovery; — addressing appropriate critical safety and security issues.

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Table C.2 — Key work product characteristics (cont.)

ID	*WP class*	WP Type	WP Characteristics
			— Provides a description of how to store the product including: — storage environment required — the protection media to use — packing materials required — what items need to be stored — assessments to be done on stored product — Provides retrieval instructions
81	*3.2*	Acceptance record	— Record of the receipt of the delivery — Identification of the date received — Identification of the delivered components — Records the verification of any customer acceptance criteria defined — Signed by receiving customer
82	*1.2*	Customer support procedure	— Coverage for key elements (as appropriate to the product or contract): — Tasks to follow in providing support defined — Defines the availability and coverage the support provided: — hot-line # — hours of availability — appropriate expertise — cost — Defines a schema for classification of customer request and /or problems: — definition of request type — definition of priority/severity — definition of response time expectations, by type and severity — Standards for what information to retain from a customer, such as: — company and location — contact information details — description of the request — reference to supporting information sent (dumps, files) — customer system site configuration information (product, release, version, last update) — impacted system(s) — impact to operations of existing systems — criticality of the request — expected customer response/closure requirements — Definition of customer escalation procedures — Identification of *customer support tools* available and procedures for using them, such as: — mechanism used to record customer requests — status reports — systems available to reproduce problems — ability to reproduce customers software environment — ability to reproduce problems — rest emulators — rest scripts

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Table C.2 — Key work product characteristics (cont.)

ID	*WP class*	WP Type	WP Characteristics
			— dial-in ports — dump analysis tools
83	*3.2*	Customer request record (internal or external)	— Identifies request purpose, such as: — new development — enhancement — internal customer — operations — documentation — informational — Identifies request status information, such as: — date opened — current status — date assigned and responsible owner — date verified — date closed — Identifies priority/severity of the request — Identifies customer information, such as: — company/person initiating the request — contact information and details — system site configuration information — impacted system(s) — impact to operations of existing systems — criticality of the request — expected customer response/closure requirements — Identifies needed requirements/standards — Identifies information sent with request (i.e., RFPs, dumps, etc.)
84	*3.2*	Problem report record	— Identifies the name of submitted and associated contact details — Identifies system configuration information (such as: release versions, system software, hardware configuration, etc.) — Identifies the group/person(s) responsible for providing a fix — Includes a description of the problem — Identifies any associated support information (dumps, files, etc.) — Identifies the severity of the problem (critical, major, minor..) — Identifies the status of the reported problem — Identifies the components of the product affected — Identifies the applicable software product release and version information — Identifies the date "opened" — Identifies the target release(s) problem will be fixed in — Identifies the expected closure date — Identifies any associated problem reports, customer requests, duplicate problems, associated fixes — Identifies any closure criteria — Identifies re-inspection actions

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Table C.2 — Key work product characteristics (cont.)

ID	*WP class*	WP Type	WP Characteristics
85	*3.2*	Customer satisfaction survey	— Identification of customer and customer information — Date requested — Target date for responses — Identification of associated software and hardware configuration — Ability to record feedback

86	*3.4*	Customer satisfaction data	— Determines levels of customer satisfaction with software products and services
			— Mechanism to collect data on customer satisfaction:
			  — results of field performance data
			  — results of customer satisfaction survey
			  — interview notes
			  — meeting minutes from customer meetings

87	*1.2*	Communication mechanism	— A way to distribute information: — Clear description of what is being communicated — Ability to specify date information sent — Ability to distribute to all impacted — Identification of the impact: (software, development, customer, organization, etc.) — Provides a clear identification as to who/what the message applies — Mechanism for recipient to respond when required (return information) — The distribution media used is accessible to all with a need to know — The distribution list is current and includes all with a need to know — Ability to specify target return date information
88	*1.4 / 2.1*	Training strategy/plan + (16)	— Defines current staff capabilities — Defines the skills required — Outlines course available to achieve training goal

89	*3.2*	Training record	— Record of employee's training
			— Identifies employee's name
			— Identifies any courses taken (date, hours, course title)
			— Identifies current skills/capabilities/experience level, lists:
			  — formal education
			  — in-house training
			  — mentoring
			— Identifies future training needs
			— Identifies current status of training requests

90	*2.5*	Training material	— Synchronized to current supported versions of the software — Updated and available for new releases — Coverage of system, application, operations, maintenance as appropriate to the application — Courses listings and availability
91	*1.4 / 2.1*	Configuration management (CM) strategy / plan + (16)	— Defines or references the procedures to control changes to configuration items — Defines measurements used to determine the status of the CM activities — Defines CM audit criteria

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Table C.2 — Key work product characteristics (cont.)

ID	*WP class*	WP Type	WP Characteristics
			— Approved by the CM function — Identifies configuration library tools or mechanism — Includes management records and status reports that show the status and history of controlled software items — Specifies the location and access mechanisms for the CM library. — Archival and retrieval mechanism specified
92	*2.4*	Configuration management (file, library, system)	— Version control — Storage and retrieval of configuration items (and their versions); — Sharing and transfer of configuration items between affected groups; — Effective controls over access; — Maintain configuration item descriptions — Recovery of archive versions of configuration items; — Correct creation of products from the library. — Can recreate any release or test configuration — Ability to report configuration status — Changes to configuration items are tracked to change/user requests

93	*2.5*	Configuration item	— Item which is maintained under configuration control (software, documents, work products)
			— Version identification is maintained
			— Description of the item is available including things like:
			  — type of item
			  — associated configuration management library, file, system
			  — responsible owner
			  — date when place under configuration control
			  — status information (i.e., development, baselined, released)
			  — relationship to lower level configured items
			  — identification of the change control records
			  — identification of change history

94	*3.2*	Change request	— Identifies purpose of change — Identifies request status (new, accepted, rejected) — Identifies requester contact information — Impacted system(s) — Impact to operations of existing system(s) defined — Impact to associated documentation defined — Criticality of the request, date needed by

95	*3.2*	Change control record	— Used as a mechanism to control change to baselined products/ products in official project release libraries
			— Record of the change requested and made to a baselined product (work products, software, customer documentation, etc.)
			  — identification of system, documents impacted with change
			  — identification of change requester
			  — identification of party responsible for the change
			  — identification of status of the change
			— Linkage to associated customer requests, internal change requests, etc.
			— Appropriate approvals

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Table C.2 — Key work product characteristics (cont.)

ID	*WP class*	WP Type	WP Characteristics
			— Duplicate requests are identified and grouped
96	*3.2*	Change history	— Historical records of all changes made to an object (document, file, software module, etc.) — description of change — version information about changed object — date of change — change requester information — change control record information
97	*3.2*	Corrective action (logs, plans, minutes)	— Identifies the initial problem — Identifies the ownership for completion of defined action — Defines a solution (series of actions to fix problem) — Identifies the open date and target closure date — Contains a status indicator — Indicates follow up audit actions
98	*2.5*	Tracking system	— Ability to record customer and process owner information — Ability to record related system configuration information — Ability to record information about problem or action needed — date opened and target closure date — severity/criticality of item — status of any problem or actions needed — information about the problem or action owner — priority of problem resolution — Ability to record proposed resolution or action plan — Ability to provide management status information — Information is available to all with a need to know — Integrated change control system(s)/records
99	*2.5*	Work-around (temporary solutions)	— Problem identification — Release and system information — Temporary solution, target date for actual fix identified — Description of the solution — limitations, restriction on usage — additional operational requirements — special procedures — applicable releases — Backup/recovery information — Verification procedures — Temporary installation instructions
100	*2.5*	Product configuration	— Overview of the system's configuration — Defines each component and their position in the architecture of the system — Defines the key system interfaces — Defines any network considerations — Defines the hardware configuration — Defines any system performance/parameter settings
101	*2.3*	Database design	— *Coverage for key elements (as appropriate to the application):* — Definition of design characteristics:

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Table C.2 — Key work product characteristics (cont.)

ID	*WP class*	WP Type	WP Characteristics
			— database management system used — type of system (relational, hierarchical, object oriented, networked) — format of records, tables, objects — database access mode — associated software (programs, user screen formats, reports) — supported database language — Definition of logical and physical views, models: — records (data layouts, fields, tables, structures) — field names and definitions — data definitions, classes, structure, etc. — entity / relationships — classes, inheritance scheme — Definition of user views — screen layouts — field access — data access — commands — Input / output interface considerations — Database usage information (contents, application systems, usage restrictions, etc.) — Identification of constraints: — security considerations — data access considerations — back-up and recovery considerations — system restart considerations — system generations considerations — performance considerations
102	*3.2*	Back-up / recovery record	— Date of back-up — Listing of what was backed-up with associated versions — Listing of where it was backed-up to — Identification of associated system attributes and configuration at time of back-up — Identification of associated recovery procedures
103	*1.4 / 2.1*	Recovery strategy / plan	— Identifies what is to be recovered: — procedures / methods to perform the recover — schedule for recovery — time required for the recovery — critical dependencies — resources required for the recovery — list of backups maintained — staff responsible for recovery and roles assigned — special materials required — required work products — required equipment — required documentation — locations and storage of backups

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Table C.2 — Key work product characteristics (cont.)

ID	*WP class*	WP Type	WP Characteristics
			— contact information on who to notify about the recovery — verification procedures — cost estimation for recovery
104	*2.5*	Development environment	— Floor plan — Environmental safety considerations — Regulatory requirements — Contractual requirements — Security considerations — Facility configuration — Special environmental requirements — (e.g. air conditioning, raised floor, power, etc.) — Individual workspace needs defined — Workstations requirements — Supporting software — Tools — Communication equipment — Disaster recovery plan
105	*2..5*	Customer documentation	— Coverage for key elements : user manual, operation manual, maintenance manual, etc., as appropriate to the application*:* — *External system documents:* — system overview, architecture, design guide — feature guide (functional descriptions of system components) — diagnostic guide: error messages and codes — operating commands reference guide — installation, operations and maintenance guide — technical support guide — *Internal customer documents:* — requirements — designs — test plans — plans — records — Documentation kept synchronized with latest associated software release: — available with delivery of a new or changed version of the software — updated with maintenance releases (as appropriate to change request resolution) — Ordering procedures — Current site distribution and maintenance list maintained
106	*3.2*	Installation record	— Record of what was installed — Release and system configuration information recorded — Special site specific information recorded — Identification of any acceptance testing performed — Installation performance information captured : — number of faults found after the installation or conversion — time to install

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Table C.2 — Key work product characteristics (cont.)

ID	*WP class*	WP Type	WP Characteristics
			— Ability to bring up system after installation conversion — Customer approval signatures
107	*2.5*	System component	— Hardware components — Software components — Manual components — Customer documentation — Training materials
108	*3.2*	Personnel record	— Relevant information about personnel including: — Name, address, date of birth, marital status — Grade, pay, appraisal history — Disciplinary history
109	*3.2*	Contract review record + (31)	— Scope of contract and requirements — Possible contingencies or risks — Alignment of the contract with the strategic business plan of the organization — Protection of proprietary information — Requirements which differ from those in the original documentation — Capability to meet contractual requirements — Responsibility for subcontracted work — Terminology — Customer ability to meet contractual obligations.

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Annex D
(informative)

Style guide for defining base practices

This annex gives guide-lines for defining base practices. Base practices are used in this exemplar assessment model as software engineering or management activities that address the purpose of a particular process.

A base practice description consists of the following components:

— practice identifier;

— practice name;

— practice description;

— optionally, additional notes on the practice.

Table D.1 gives guide-lines for each of these components.

Table D.1 — Guide-lines for describing Base Practices

Component	Guideline
Practice identifier	1. Each base practice belongs to a specific process within a process category. 2. Each base practice has a unique identifier of the form: PC.PR."BP"PT where: PC is the identifier of the process category PR is the identifier for the process within the process category "BP" is used to signify Base Practice PT is the identifier of the specific practice within the process
Practice name	1. The name of the base practice should identify what the practice does in summary form. 2. In general, the name should be an action-oriented phrase, beginning with a verb which summarizes the action, e.g., "Plan," "Establish," "Build," etc., and followed by a word or phrase that describes what is to be accomplished; e.g. "Identify the need" 3. The practice name appears on the same line as and immediately after the practice identifier.
Practice description	One or more sentences that amplify the practice name.
Informative notes	Optionally, notes may be appended to the base practice to further describe the practice, to give examples, or to provide cross-references to other practices.

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Annex E
(informative)

Style guide for defining management practices

This annex gives guide-lines for defining management practices. Management practices are used in this assessment model to refine the description of the process attributes of the reference model.

A management practice description consists of the following components:

— practice identifier;

— practice description;

— optionally, additional notes on the practice.

A management practice is also associated with a further set of indicators of process capability:

— Process performance characteristics;

— Resource and infrastructure characteristics; and

— Associated processes.

Table E.1 gives guide-lines for each of these components.

Table E.1 — Guide-lines for describing management practices

Component	Guideline
Practice identifier	1. Each management practice belongs to a specific process attribute (within a capability level). 2. Each management practice has a unique identifier of the form: "MP"CL.PA.PT where: "MP" is used to signify Management Practice CL is the identifier of the capability level PA is the identifier for the process attribute within the capability level; PT is a unique number for this management practice
Practice description	1. The description of the management practice should identify what the practice does in summary form. 2. In general, the description should be an action-oriented phrase, beginning with a verb which summarizes the action, e.g., "Plan," "Establish," "Build," etc., and followed by a word or phrase that describes what is to be accomplished; e.g. "Identify the need" followed by the purpose of performing this practice, e.g., “perform this practice” TO “achieve this outcome”. 3. The practice description appears on the same line as and immediately after the practice identifier.
Informative notes	Optionally, notes may be appended to the management practice to further describe the practice, to give examples, or to provide cross-references to other practices.

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Component	Guideline
Process performance characteristics	Observable evidence that characterizes the performance of this practice.
Resource and Infrastructure characteristics	Observable tools, techniques, support mechanisms, facilities, qualifications of human resources, etc.
Associated processes	Processes from the process dimension that could enhance or contribute to the effective implementation or assessment of this practice.

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Bibliography

1. ISO/IEC 9126:1991, *Software Quality Characteristics*

2. ISO/IEC 12207: 1995, *Information Technology - Software life cycle processes.*

The following documents contain definitions and may provide general guidance to terms in the indicator set.

3. ISO/AFNOR: 1997, *Dictionary of Computer Science*

4. ISO 8402: 1994, *Quality management and quality assurance - Vocabulary*.

5. ISO/IEC 2382-1: 1993, *Information Technology - Vocabulary - Part 1: Fundamental terms*.

6. ISO/IEC 2382-20: 1990, *Information Technology - Vocabulary - Part 20: System development*.

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